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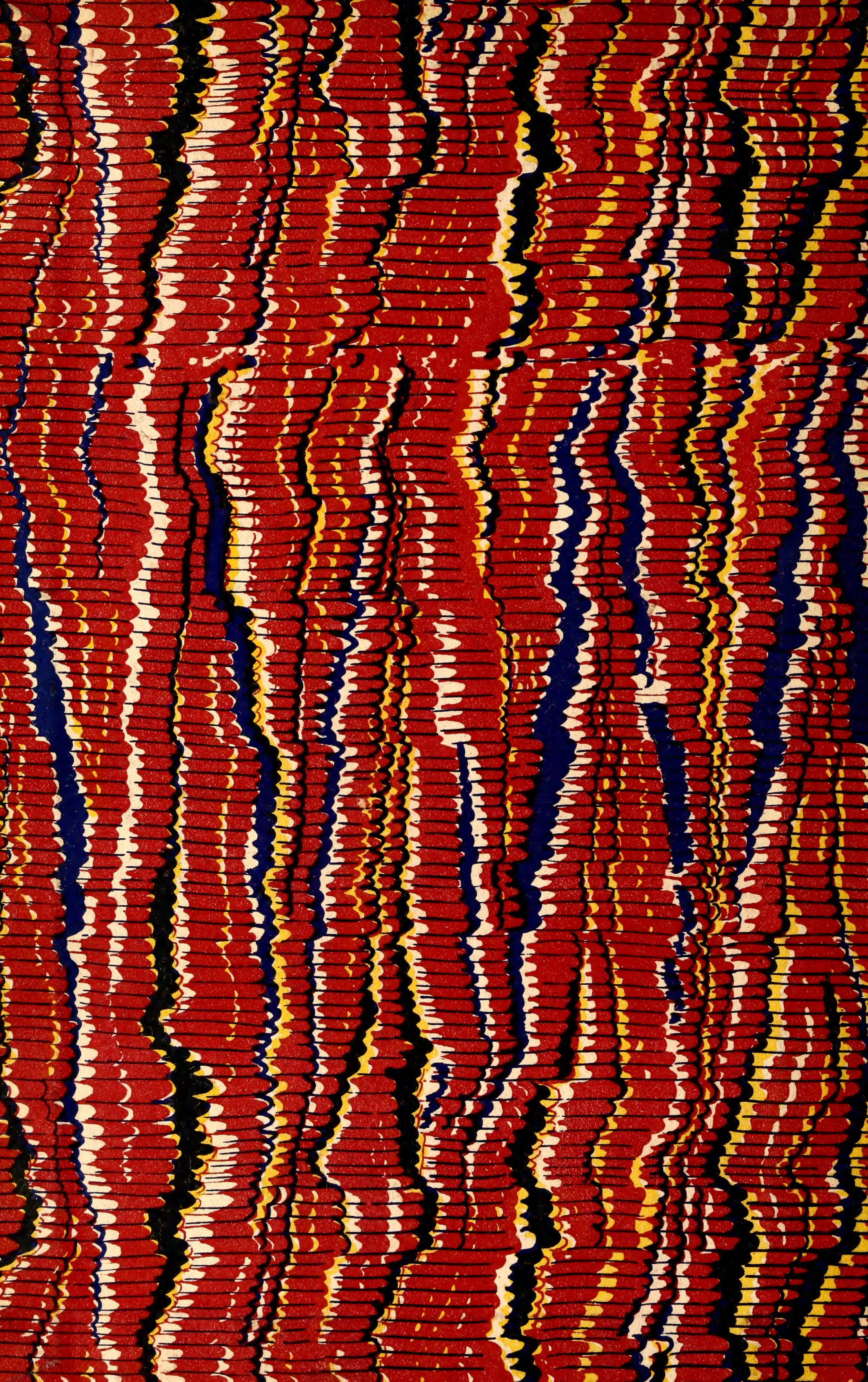

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Foulkes, R.	Madura.
Foulkes, Lt.-Col. T. H. (I.M.S.) (*Life Member*)	Europe.
Fountaine, Miss Margaret (F.E.S.)	London.
Fraser, Duncan	London.
Fraser, Lt.-Col. F. C. (I.M.S., M.D., F.L.E.S.)	London.
Fraser, J. S.	London.
Fraser, Major S. G. G.	Bombay.
Fraser, Sir Stuart (I.C.S., K.C.S.I., C.I.E.)	Bombay.
Frederickson, H.	Beccles, England.
Frei, Max (*Life Member*)	Zurich, Switzerland.
French, H. A. L.	Karachi.
Frenchman, D. P. (B.SC.)	Gandamanayakanur.
Frend, G. V. R.	Balehonur.
Frere, Major A. G. (I.A., F.Z.S.) (*Life Member*)	London.
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Gairdner, K. G.	Lakon-Lampang.
Gallant, M. N. (B.SC., I.F.S.)	London.
Gamlen, R. L.	Hyderabad, Dn.
Gammie, Prof. G. A. (*Life Member*)	London.
Gangpur, Ruling Chief	Sundergarh.
Garbett, C. C. (I.C.S.)	Bombay.
Gauripur, Raja Prabhatchandra Barna (*Life Member*)	Gauripur.
Gaye, W. C.	Arlington.
Gentle, J. A. R. (I.F.S.)	Mandla.
Geoghegan, Mrs. O. A.	Simla.
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Gharpurey, Lt.-Col. K. G. (I.M.S.) (*Life Member*)	Ahmednagar.
Gibbs, A. F.	Umaria.
Gibson, E. C. (I.C.S.)	Ajmer.
Gilbert, C. E. L. (I.F.S.)	Karachi.
Gilbert, T.	Europe.
Gill, E. H. N. (F.Z.S.)	Budaun.
Gill, H.	Kalain.
Gillespie, Major F. S. (M.D., R.A.M.C.)	Ootacamund.
Gillett, B. G. (O.B.E.)	Bombay.
Gimson, C. (I.C.S.)	Nowgong.
Girsperger, F.	Bombay.
Gladstone, Capt. H. S. (F.Z.S., F.R.S.E.)	Capenoch-Scotland.
Gladstone-Solomon, Capt. W. E. (I.E.S.)	Bombay.
Glascock, L. C. (M.V.O., C.I.E.)	Jaipur.

Glass, E. L.	Ranchi.
Glennie, Major E. A. (D.S.O., R.E.)	Dehra Dun.
Glover, H. M.	England.
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Goldie, Dr. E. A. (M.C., I.M.S.)	Lahoal, Assam.
Gondal, Kumar Shree Nutversinhji	Jetalsar.
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Gordon, Major J. W.	Jodhpur.
Gordon, R. G. (I.C.S.)	Nasik.
Gore, F. W.	England.
Gothorp, Percy	Assam.
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Deputy Director of Agriculture, East Central Circle.	Pyinmana.
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Graham, Sir L. (C.I.E., I.C.S., K.C.I.E.)	London.
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Hamid Khan, M. (M.SC., F.R.M.S.)	Lahore.
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Hance, Major J. B. (O.B.E., I.M.S.)	Bombay.
Hancock, Major C. P.	England.

Hanhart, S.	Bombay.
Hare, Lt.-Col. G. A. (R.A.)	Kirkee.
Harman, A. C.	Bettiah.
Harper, Lt.-Col. A. Forrest	London.
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Harris, W. (M.R.C.V.S.)	Gauhati.
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Harrison, Mrs. H. Z.	Bombay.
Hartigan, Capt. G. E. R. S. (M.C.)	Lansdowne.
Hartnoll, E. S. (I.F.S.)	Bhamo.
Harvey, Capt. C. W, L. (M.C.)	New Delhi.
Hasted, Capt. J. S. H.	Dehra Dun.
Hastings, J. R. G.	London.
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Hâte, Prof. Vinayakrao N. (B.SC.)	Bombay.
Haughton, Lt.-Col. H. L. (C.I.E.)	Bombay.
Hawes, C. G.	Bombay.
Hay, Major R. (I.M.S.)	Dera Ismail Khan.
Hayes, A.	Shwebo.
Heaney, Capt. G. F. (R.E.)	Maymyo.
Hearsey, Capt. L. D. W. (M.C., V.D.)	Kheri.
Hector, G. P. (M.A., D.SC.)	Dacca.
Heilner, Van Campen (M.SC., F.R.G.S., F.R.A.I.)	New Jersey.
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Henderson, Lt.-Col. D.	Mhow.
Henderson, J. L.	Quilon.
Heron, F. A. T.	Europe.
Hewetson, C. E. (I.F.S.)	Bombay.
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Hickie, W. A.	Singapore.
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Hiley, A. C. (I.F.S.)	Dharwar.
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Hill, Major R. D. O. (*Life Member*)	London.
Hingston, Major R. W. G. (I.M.S.)	London.
Hislop, Major J. H. (M.C., I.M.S.)	Mhow.
Hodgson, R. C.	Colombo.
Hogg, Capt. R. G.	Quetta.
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Holmes, H. R.	England.
Homfray, Jeston (I.F.S.)	Calcutta.
Hopkinson, A. J. (I.C.S.)	Wadhwan.
Hopwood, S. F. (I.F.S.) (*Life Member*)	Rangoon.
Hora, Dr. Sunder Lal (D.SC.)	Calcutta.
Horner, Capt. B. Stuart	Hazara.
Horst, W. (I.S.E.)	Shibnagar.
Horticulturist, Municipal Gardens, The	Karachi.

Hoshang, N. E. Dinshaw	Karachi.
Hotson, Hon'ble Sir Ernest (K.C.S.I., O.B.E., I.C.S.) (*Life Member*)	Bombay.
Hotz, E.	Agra.
Howard-Bradshaw, Lt.-Comdt. C. T. (R.N.) ...	London, W. 14.
Howell, E. Berkley (C.I.E., I.C.S.)	Srinagar.
Hoyos, Count E. (*Life Member*)	Austria.
Hudson, Major-Genl. Corrie (C.B., C.I.E., D.S.O., K.H.S., I.M.S.)	London.
Hudson, Sir Leslie (*Kt.*)	Bombay.
Huggins, J. R.	Sunningdale.
Hughes, A. R.	Colombo.
Hughes, Major J. E.	Bombay.
Hughes-Hallett, Capt. N. M.	Shrewsbur.
Hundley, G.	Rangoon.
Hunt, Lt.-Col. S. (I.M.S.)	London.
Husbands, Major H. W. S. (M.C., A.M.I.C.E., S.M.R.E.) (*Life Member*)	London.
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Hutchinson, Lt.-Col. W. Gordon (I.A., O.B.E.) ...	Cooch Behar.
Hutchison, L. P.	Azamgarh.
Hutton, C. H.	England.
Hutton, C. I.	Insein.
Hyam, Khan Bahadur Judah (G.B.V.C., F.Z.S.) (*Life Member*)	Poona.
Ibbotson, Capt. A. W. (M.C., E.B.E., I.C.S.) ...	Puri.
Ichalkaranji, The Hon'ble Meherban Narayan Govind *alias* Babasaheb Ghorpade (*Life Member*) ...	Ichalkaranji.
Idar, H.H. Maharajadhiraj Lt.-Col. Shree Sir Dowlat Singhji (K.C.S.I.) (*Life Member*)	Himatnagar.
Imperial Council of Agricultural Research ...	New Delhi.
Imperial Library, The Librarian	Calcutta.
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Indian Lac Research Institute	Namkum.
Indore, H. H. The Maharaja Yeshwantrao Holkar (*Life Member*)	Indore.
Ingham, J. L.	Bombay.
Inglis, Chas. M. (F.Z.S., M.B.O.U.) (*Life Member*) ...	Darjeeling.
Inglis, C. C.	Poona.
Irvine, A. E.	Ootacamund.
Irwin, H.E. Lord (P.C., G.M.S.I., G.M.I.E.) (*Patron*) ...	India.
Irwin, Major H. R. (I.A.S.C.)	Bombay.
Isaacs, Miss Mozelle (M.A., M.SC.)	Dombivli.
Ishwardas Lukhmidas	Bombay.
Ivens, J. H. (P.W.D.) (*Life Member*)	Europe.
Jaboville, Pierre	Europe.
Jackets, C. H.	Vizianagram.
Jackson, Dr. T. S.	Bombay.
Jacob, J. R.	Bombay.
James, Lt.-Col. F. H.	Bombay.
Jamkhandi, Shrimant Shankarrao Parashuramrao *alias* Appasaheb Patwardhan (K.C.I.E.) (*Life Member*).	Jamkhandi.

Jamsetji, M. Doctor (F.Z.S., C.M.Z.S.)	Bombay.
Jardine, W. E. (C.I.E., I.C.S.)	London.
Jarman, Capt. G. S.	Bombay.
Jatia, Sir Onkar Mull (*Kt.*, O.B.E.)	Calcutta.
Jeff, R.	Linthouse.
Jenkin, R. Trevor (I.F.S.)	Raipur.
Jenkins, J. B.	London.
Jermyn, Lt. R. O.	Bombay.
Jhalawar, H. H. The Maharaja Rana Rajendra Singh Bahadur	Jhalrapatam.
Jind, H. H. The Maharaja Sir Ranbir Singh (K.C.S.I., G.C.I.E.) (*Life Member*)	Jind.
Jodhpur, Lt.-Col. H. H. The Maharaja Sir Umaidsing Bahadur (K.C.S.I., K.C.V.O., G.C.I.E.) (*Life Member and Vice-Patron*)	Jodhpur.
John, A. W.	Ellapatti.
Johnson, Capt. A.	Trimulgherry.
Johnson, Kay	Nazira.
Jones, A. E.	Simla.
Jones, A. J. (J.P.)	Bhamo.
Jones, Capt. N. J. G.	Miranshah.
Jones, Capt. W. H. C.	Europe.
Jones, Major W. E.	Bombay.
Jourdain, Rev. F. C. R.	England.
Judge, C. E. M.	Delhi.
Jukes, Hon'ble Mr. J. E. C. (C.I.E., I.C.S.)	Simla.
Junagadh, His Highness the Nawab of	Junagadh.
Kaiser Shumsher Jung Bahadur Rana, S. M. Lt.-Genl. (*Life Member*)	Nepal.
Kanga, Miss P. M. (M. SC.)	Bombay.
Karachi, Victoria Museum, The Curator	Karachi.
Katrak, N. N.	Bombay.
Kazi, E. D. (J. P.)	Bombay.
Keays, Lt.-Col. R. W. C. (I.A.)	Madras.
Keily, H. G.	Bombay.
Kemp, W. N. R.	Peeprah.
Kempe, J. E.	Knighton.
Kennion, Lt.-Col. R. L. (F.Z.S., C.I.E.)	England.
Kermode, C. W. D. (I.F.S.)	London.
Kerr, Dr. A. F. G.	Bangkok.
Khairpur, H. H. Mir Ali Nawazkhan (*Life Member*)	Khairpur.
Khan, Sahebzada Sardar Mahomed	Karachi.
Khareghat, M. P. (I.C.S.)	Bombay.
Khetri, Raja Sarder Singh Bahadur (*Life Member*)	Khetri.
Khilchipur, H. H. Durjansal Singh (*Life Member*)	Khilchipur.
Kiddle, J. A. C.	Moulmein.
Kiernander, Major O. G.	Iraq.
Kilburne, R. G.	Nepal.
King, E. O. (I.A.R.O.)	Kodaikanal.
King, Lt.-Col. J. St. Aubyn	Jhelum.
Kinloch, Mrs. A. M.	Kotagiri.
Kirby, R. R.	Tindharia.

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Knight, H. F. (I.C.S.)	Sholapur.
Knight, L. G.	Kalthuritty.
Koechlin, E. L.	Pykara.
Koechlin, M. C.	Munnar.
Kolhapur, H. H. The Maharaja Lt.-Col. Sir Rajaram Chhatrapati (G.C.I.E.) (*Life Member*)	Kolhapur.
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Kothavala, T. T.	Sholapur.
Kunhardt, Lt.-Col. J. C. G. (I.M.S.)	London.
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Kydd, D.	London.
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Laidlay, J. C.	Scotland.
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Lakshminarayanan, C.	Madras.
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Lambert, Hon'ble Sir George (K.C.S.I., I.C.S.)	Naini Tal.
Lampard, L. A.	Quilon.
Landells, W. J.	Tamok.
Lane, H. S.	Gooty.
Latham, H. D.	Vellore.
Latif, Hasan (M.I.E., A.M.I.E.E.)	Hyderabad, Dn.
Latif, Sarhan C.	Karachi.
La Touche, J. F. D.	Rangoon.
Laud, D. S.	Bombay.
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Laurie, M. V. (I.F.S.)	Madras.
Laws, Wilfred	Teok.
Lawther, B. C. A.	Peshawar.
Layng, Brevet Major T. M. (I.A.)	Bombay.
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Lees, L. M. (I.C.S.)	Rangoon.
LeMarchand, A. E. M.	Europe.
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Leonard, D. G.	Bombay.
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Leonard, P. M. R.	Kutkai.
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Hyderabad, The Librarian, State Library	Hyderabad, Dn.
Lahore, University of Punjab, The Librarian	Lahore.
Lucknow, Public Library, The Honorary Librarian	Lucknow.
Lucknow University Library	Lucknow.
Madras, Connemara Public Library, The Principal Librarian	Madras.
Neilson Hays Library	Bangkok.
Public Library, Museums and National Gallery of Victoria, The Chief Librarian	Melbourne.
Station Library, The Honorary Secretary	Simla.
United Service Library, The Honorary Secretary	Poona.
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Lightfoot, S. St. C.	Taunggyi.
Lightfoot, Capt. G. S. (I.P.)	Assam.
Limbdi, H. H. Maharana Shri Sir Daulatsinhjee (K.C.I.E.)	Limbdi.
Limbdi, The Yuaraj Saheb of	Limbdi.
Lindberg, K.	Kurduwadi.
Lindley-Hinde, G.	Calcutta.
Lister, R. S.	Ghoom, Bengal.
Little, E.	Kirkee, Poona.
Lloyd, Col. C. R (A.S.C., D.S.O.)	Simla.
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MacDonald, R.	Chubwa.
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Mackay, J. H. (I.F.S.)	Rangoon.
Mackenzie, J. M. D. (I.F.S.) (*Life Member*)	Rangoon.

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Mackie, Lt.-Col. F. P. (I.M.S., O.B.E., K.H.S.)	London.
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Mackwood, F. M.	Colombo.
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Mac Lachlan, Capt. D.	Bombay.
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Macleod, Lt. A. J. W.	Alipore.
Macleod, R. D. (I.C.S.)	Etawah.
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Macqueen, H. C.	Dehra Dun.
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Madras, H. E. the Governor	Madras.
Mahendra, B. C. (M.SC.)	Agra.
Mahon, Col. A. E.	Kulu.
Main, T. F. (B.SC.)	Poona.
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Malcolm, C. A. (I.F.S.)	Nagpur.
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Mandlik, Narayan V. (*Life Member*)	Bombay.
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Marshall, J. McL. (*Life Member*)	Scotland.
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Maude, E. W.	Lebong.
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Maxwell, R. M. (I.C.S., C.I.E.)	Bombay.
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Mehta, J. N. R.	Karachi.
Meinertzhagen, Lt.-Col. R.	London.
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Menezes, V. T.	Goa.
Merrikin, M. S.	Rangoon.
Methold, J. H.	Calcutta.
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Miller, John I. (F.R.G.S., F.Z.S.)	Perthshire.
Miller, Lt. R.O.	Calcutta.
Mills, Major J. D. (*Life Member*)	England.
Mills, J. P. (I.C.S.)	Calcutta.
Milner, C. E.	Rangoon
Milroy, A. J. W.	Shillong.
Miraj, Shrimant Sir Gungadhar Rao Ganesh *alias* Babasaheb Patwardhan (K.C.I.E.) (*Life Member*).	Miraj.
Mirchandani, Tolo K. (B.E., A.M.I.E., B.F.S.)	Dharwar.
Mirchandani, U. M.	Karwar.
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Mitchell, F. J.	London.
Mitchell, H. H. G. (*Life Member*)	London.
Mitchell, Capt. R. S. J. (R.E.)	Europe.
Modi, Sir Jivanji Jamshetji (B.A., Ph.D., C.I.E., J.P.)	Bombay.
Mohr, Dr. V. der Meer	Medan, Sumatra.
Moloney, W. J.	Bombay.
Montagnon, D. J. (*Life Member*)	Dibrugarh.
Monte, Dr. D. A. de (L.M. & S.)	Bandra.
Monteath, G. (I.C.S.) (*Life Member*)	Belgaum.
Monteath, J. (I.C.S.)	Satara.
Montmorency, H. E. Sir Geoffrey (K.C.V.O., K.C.I.E., C.B.E., I.C.S.)	Punjab.
Mooney, H. F. (I.F.S.)	Hinoo.
Moore, Capt. A. C. (I.A.)	Ireland.
Moore, J.	London.
Moore, G. D.	Bombay.
Morden, W. J.	U. S. A.
Morgan, F. I.	Clandy.
Morgan, Major J. S. H.	Sidapur.
Morgan, R. W. D.	Calcutta.
Morison, Lt.-Col. J. (I.M.S.)	Rangoon.
Morris, Chas. W. G.	Attikan.
Morris, Lt.-Col. D. O. (*Life Member*)	London
Morris, R. C.	Attikan.
Morton, Geo. B.	Calcutta.
Morvi, H. H. The Maharaja Lakhdiriji Waghji (K.C.S.I.) (*Life Member*)	Morvi.
Mosse, Lt.-Col. A. H. E. (I.A.) (*Life Member*)	Bhavnagar.
Mott, John L.	Nagpur.

Mudhol, Shrimant Sir Malojirao Raje Ghorpade (K.C.I.E.)	Mudhol.
Muir, Wm. Angus (M.A., M.C., I.F.S.)	London.
Mullan, Prof. J. P. (M.A., F.Z.S., F.L.S.)	Bombay.
Muller, Dr. H. C. (D.SC.)	Bombay.
Mulroney, J. T.	Kurseong.
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Munns, F. A. C.	Turkaulia.
Murland, Major H. F. (*Life Member*)	Suntikoppa.
Murphy, P. J.	Ramna Dacca.
Mursell, D. F.	London.
Musgrave-Hanna, Capt. J. R.	Fort Sandeman.
Mysore, The Director of Agriculture	Bangalore.
Mysore, Government Museum, The Superintendent	Bangalore.
Mysore, H. H. The Maharaja Sir Krishnaraj Woodayar Bahadur (G.C.S.I., G.B.E.) (*Life Member*)	Mysore.
Nagpur, Central Museum, The Curator	Nagpur.
Namjoshi, V. K. (*Life Member*)	Bombay.
Naraenji Dwarkadas (*Life Member*)	Bombay.
Narayanlal Bansilal, Raja (*Life Member*)	Bombay.
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Nash, H. J.	Ajmer.
Nawanagar, H. H. The Jam Saheb (K.C.S.I., C.B.E., (*Life Member*)	Jamnagar.
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Neathan, A. P.	Bombay.
Needham, F. M.	Murkong-Sellek.
Nehru, Dr. S. S. (PH.D., M.A., LL.D., I.C.S.)	Naini Tal.
Nepal, Supradipta Manyaber General Mohun Sumshere Jung Bahadur Rana (K.C.I.E.) (*Life Member*)	Nepal.
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Nicholson, Lt.-Col. F. L. (D.S.O., M.C.)	Quetta.
Nicholson, Lt.-Col. M. A. (I.M.S.)	Bombay.
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Osmaston, B. B. (C.I.E., I.F.S.)	Oxford.
Osmaston, F. C. (I.F.S.)	Sambalpur.
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Parlett, L. M. (I.C.S.) (*Life Member*)	England.
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Paterson, T. R.	Neora.
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Patiala, Capt. Rao Raja Birindra Singhji (*Life Member*)	Patiala.
Patiala, H. H. the Maharaj Kumar Brijindra Singhji	Patiala.
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Peppe. Capt. F. H.	Basti.
Percival, A. P. (I.F.S.)	England.
Perfect, E.	England.
Pershouse, Major Stanley	London.
Pestonji Jivanji (N.C.S.) (*Life Member*)	Hyderabad, Dn.
Petit, Dhunjibhoy Bomanji (*Life Member*)	Bombay.
Petit, Jehangir Bomanji (*Life Member*)	Bombay.

Petit, S. C. D.	Bombay.
Petit, F. C.	Bombay.
Petley, C. A.	Toungoo.
Phayre, Lt.-Col. R. B. (M.C.)	London.
Phillips, A. A. (I.S.R.)	Dehra Dun
Phillips, Charles H.	Sonari.
Phillips, W. W. A.	Gammaduwa.
Phipson, H. M. (F.Z.S.) (*Life Member*)	London.
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Piggott, R. L.	Sangameswarpet.
Pinhey, Capt. L. A. G.	Ziarat.
Pipe, T. S.	Karachi.
Pitman, Major C. R. S.	England.
Pizey, R. M.	Gohpur.
Pogson, Major F. V.	Bombay.
Poncins, Viscount Edmund de (*Life Member*)	France.
Pope, J. A. (I.C.S.)	Indore.
Porbandar, H. H. The Maharaja Shri Natwarsinghji Bhavsinghji Rana Saheb	Porbandar.
Porteous, A. B.	Bhilad.
Prendargast, H. V.	Cawnpore.
Primrose, F. A.	Bombay.
Procter, Miss Joan B. (F.Z.S.)	London.
Puckle, Capt. H.	Ambala.
Pudukottai, State Museum, The Curator	Pudukottai.
Pullan, A. U.	Matelli.
Purkis, F. C. (B.E.S.)	Rangoon.
Purkis, H. Vernon	Wazirabad.
Purvis, J. L. F.	Mergui.
Quarry, P. S.	Dehra Dun.
Radhanpur, H. H. Shri Jalaluddin Khanji (*Life Member*)	Radhanpur.
Rae, Lt.-Col. M. E. (I.A.) (*Life Member*)	Abbottabad.
Ragg, H. A.	Munnar.
Raitt, W. Chas.	Kutta.
Rajadhyaksha, G. S. (I.C.S.)	Bombay.
Rajgarh, H. H. Raja Rawat Sir Birendra Singh (K.C.I.E.) (*Life Member*)	Rajgarh.
Ralston, Lt.-Col. W. H. (D.S.O., I.A.)	London.
Rampur State, Col. H. H. Nawab Sir Syed Mahomed Hamid Ali Khan Bahadur	Rampur.
Rane, K. R. (M.M. and S.P.)	Andheri.
Ranicar, E. E.	Valparai.
Ravenshaw, Col. C. W. (*Life Member*)	London.
Rayner, A. B. (I.S.E.)	Sargodha.
Readymoney, N. J.	Bombay.
Rees, H. N.	Tavoy.
Rees, R.	Mazbat.

REGIMENTAL OFFICERS' MESSES—

The Royal Engineers	Roorkee.
The Royal	Trimulghery.

Regimental Officers' Messes—*continued.*

Royal Irish Fusiliers	Agra.
Small Arms School	Ahmednagar.
1st Bn. The Worcestershire Regiment	Meerut.
1st Kings Shropshire	Poona.
6th D.C.O. Lancers	Meerut.
Queen Victoria's Own Madras Sappers and Miners	Bangalore.
1st Bn. 2nd Bombay Pioneers	Bombay.
1/6th Rajputana Rifles	Razmak.
3/6th Rajputana Rifles	Landi Kotal.
1st Royal Bn. 9th Jat. Regt. L.I.	Fyzabad.
4/10th Baluch Regiment	Quetta.
1/12th F. F. Regt. (P. W. O. Sikhs)	Jhansi.
4/12th F. F. Regt. (Sikhs)	Ambala.
6/13th Royal F. F. Rifles	Delhi.
3/15th Punjab Regiment	Allahabad.
3/17th Dogra Regiment (Semi-*Life Member*)	Alipore.
2/1st K.G.O. Gurkha Rifles	Razmak.
2nd K.E.O. Gurkhas	Dehra Dun.
1/10th Gurkha Rifles (Semi-*Life Member*)	Fort Sandeman.
1st Bn. Rifle Brigade	Jullunder.
60th Rifles	Lucknow.
Reid, E. C.	Bombay.
Reid, Mrs. D. W. (*Life Member*)	Bombay.
Reuben, D. E. (I.C.S.)	Cuttack.
Rewa, H. H. The Maharaja Gulabsingh Bahadur (K.C.S.I.) (*Life Member and Vice-Patron*)	Rewa.
Reynolds, Hon'ble Mr. L. W. (C.I.E., C.S.I., I.C.S.)	Ajmer.
Ribeiro, J. (L.C.E.) (*Life Member*)	Santa Cruz.
Richards, B. D. (B.SC.)	England.
Richardson, F. D. S.	England.
Riches, F. C.	Rydak.
Richmond, G. N.	Bhamo, Burma.
Richmond, R. D. (I.F.S.)	Madras.
Ridland, J. G.	Bombay.
Rishworth, Dr. H. R. (I.M.S.)	Bombay.
Ritchie, Lt.-Col. W. D. (I.M.S.)	Tezpur.
Roberts, Dr. C. L. Digby	Mariani, Assam.
Roberts, Major F. C. (V.C., D.S.O., M.C.)	Khartoum.
Roberts, H. V. H.	Karachi.
Robertson, Lawrence (C.S.I., I.C.S.)	England.
Robinson, A. C.	Bedford.
Robinson, G. C.	Manantoddy.
Robinson, Capt. J. A.	Miranshah.
Robinson, Mrs. R. B.	Negapatam.
Rodger, A. (I.F.S., O.B.E.)	Dehra Dun.
Rogers, C. G. (I.F.S.)	London.
Rogers, Rev. K. St. A. (C.M.S.)	Nairobi.
Rogerson, A. M.	Rangoon.
Rondano, Rev. A. (S.J.)	Kodialboil.
Roosevelt, Kermit (*Life Member*)	New York.
Roosevelt, Col. Theodore (*Life Member*)	New York.

Roper, Lt. J. R. Stockley (R.A.)	Chitral.
Ross, Lt.-Col. E. J.	London.
Ross, Major Tyrell (*Life Member*)	England.
Roumania, H.M. King Carol (*Life Member*)	Roumania.
Row, Dr. R. (M.D.)	Bombay.
Rowland, J. W. (I.P.)	Satara.
Rowson, W. S.	Vandi-Periyar.
Roy, R. Trevor	Pegu.
Ruddle, W. H.	Madras.
Russell, Lt.-Col. G. H. (C.I.E., D.S.O.)	Damdil.
Russell, Major J. Bertrand	Saklaspur.
Rustomjee, Miss Sherene B.	Bombay.
Ruttledge, Capt. R. F. (M.C.)	Peshawar.
Sanders, Major C. W. (*Life Member*)	Jullunder.
Sanders, D. F.	Amritsar.
Sanderson, Henry	New York.
Sanderson, P. M. D. (F.Z.S.)	Bombay.
Sangli, Meherban Sir Shrimant Chintamanrao Appasaheb Patwardhan (K.C.S.I.) (*Life Member*)	Sangli.
Sant, Maharana Shri Jarwar Sinhji, Raja Saheb of	Sant-Rampur.
Sarangarh, Raja Bahadur Jawahir Singh	Sarangarh.
Sarawak Museum, The Curator	Kuching.
Sarma, M. R. Venkatarama	Aduturai.
Satya Churn Law, Dr. (M.A., B.L., Ph.D., F.Z.S., M.B.O.U.)	Calcutta.
Saunders, H. F.	Madras.
Saunders, J. A. (I.C.S.)	Patna.
Saunders, L. (I. P.)	Chittor.
Saunders, Lt.-Col. F. W. (R.E.)	London.
Savantwadi, H. H. The Sardesai	Savantwadi.
Savile, Sir L. (C.B.) (*Life Member*)	London.
Sawyer, H. H.	Bombay.
Schmid, W. (*Life Member*)	Kreuzlingen.
Schomberg, Lt.-Col. R. C. F. (D.S.O.)	Herefordshire.
Scott, A. G.	Jubbulpore.
Scott, C. W. (I.F.S.)	Rangoon.
Scott, Major F. B. (I.A.)	London.
Scott, J. Ramsay	Cawnpore.
Scott, R. L. (*Life Member*)	Greenock.
Scroope, Capt. C. F.	Bombay.
Searight, Capt. E. E. G. L. (M.C., R.E.)	Bangalore.
Seaton, E. A. (I.F.S.)	Mogok.
Secretary for Agriculture, S. S. and F.M.S.	Kuala Lumpur.
Seervai, Dr. Rustom F.	Bombay.
Sethna, C. B.	Bombay.
Seton-Karr, Capt. H. W. (*Life Member*)	London.
Sevastopulo, D. G. (F.E.S.)	Calcutta.
Seymour-Sewell, Lt.-Col. R. B. (I.M.S.)	Calcutta.
Shah, Major B. (I.M.S.)	Belgaum.
Shanks, A. D.	Bombay.
Shannon, G. C. (I.C.S.)	Rajkot.
Sharif, M. (M.Sc., F.R.M.S.)	Calcutta.

Shaw, G. E.	Riyang.
Shaw, G. L.	Hatipatha.
Shaw, Col. H. D.	Kohat.
Shaw, John (B.F.S.)	Hsipaw.
Shebbeare, E. O.	Darjeeling.
Shephard, T. F. G.	Bombay.
Sheppard, S. T.	Bombay.
Sherred, P. R.	Ramgarh.
Sherriff, Capt. George (R.A.)	Bombay.
Shipp, G. W. I.	Glasgow.
Shirley, G. S.	Rangoon.
Shortt, Major H. E. (I.M.S.)	Bombay.
Shortt, W. H. O.	Calcutta.
Shoveller, H. L. (A.C.A.)	Bombay.
Silvester, C. N. (I.S.R.)	Quetta.
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Simmons, R. M.	Abu Road.
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Sitwell, Major N. S. H. (R.A.)	Paris.
Skinner, Lt.-Col. J. M. (I.M.S.)	Bombay.
Skrine, Capt. P. R. H.	London.
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Sladen, Dr. R. J. L. (F.R.C.S.)	London.
Slater, A. F. (A.M.I.M.E., M.B.E.)	London.
Slingsby, Major T.	Wellington.
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Smith, H. C. (*Life Member*)	London.
Smith, Major G. de Heriez (*Life Member*)	Ootacamund.
Smith, Dr. Malcolm	London.
Smyth, C. P.	Alipore.
Smyth, J. L.	Madapur.

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Symons, Major-General T. H. (I.M.S., O.B.E., C.S.I., K.B.E.)	Simla.
Tait, Major H. C. (I.M.S.)	Bombay.
Talcher, Raja Kishorechandra	Talcher.
Taleyarkhan, K. M. (Bar-at-Law)	Bombay.
Tasker, T. J. (O.B.E., I.C.S.)	Hyderabad, Dn.
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Taylor, Lt.-Col. J. (D.S.O., I.M.S.)	Rangoon.
Taylor, Dr. W. R. (M.R.C.S., L.R.C.S., D.P.H.)	Insein.
Tehri, Garhwal State, H. H. Raja Narendra Shah Saheb Bahadur (C.S.I.) (*Life Member*)	Tehri.
Tejpal, Laxmidas G. G.	Bombay.
Thatcher, E. C.	Sahuspur.
Theobald, Lt. J. A.	London.
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Thomas, B. S.	Muscat.

Thomas, P. J. P.	Calcutta.
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Thomson, Major D. B.	England.
Thomson—Glover, Capt. J. W. (*Life Member*)	Malakand.
Throne, J. A. (I.C.S.)	Vallam, Tanjore.
Thronton, H. A. (C.I.E., I.C.S.)	Maymyo.
Thursfield, R. M. C.	Shwebo.
Tibbs, Rev. Canon P. G.	Chelsea.
Ticehurst, Dr. C. B. (M.A., M.B.O.U., R.A.M.C.)	England.
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Tombazi, N. A. (F.R.G.S., A.C.)	Calcutta.
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Traylen, G. D.	Bombay.
Treasuryvala, N. J.	Bombay.
Treuthardt, M.	Calcutta.
Trevenen, Major W. B.	Jubbulpore.
Triggs, Bernard	Europe.
Trivandrum, The Govt. Mus. and Public Garden, The Superintendent	Trivandrum.
Trotter, Genl. E. W.	Bangkok.
Tunstall, A. C.	Cinnamara.
Turkhud, Dr. D. A. (M.B.C.M., etc.)	Kodaikanal.
Turner, G. M.	Mergui.
Turner, Sir Montague	London.
Tutein-Nolthenins, A. C.	Ohiya.
Twinberrow, J. D. (M.C., I.P.)	Amritsar.
Tyrrell, Lt.-Col. J. R. (I.M.S.)	London.
Tyson, John D. (I.C.S.)	Calcutta.
Tytler, Major-Genl. Sir Harry (K.C.B., C.I.E., C.M.G., D.S.O.)	England.
Ubsdell, A. R.	Calcutta.
University of Amoy, The Head of the Department of Zoology	Amoy, China.
University of Calcutta, The Librarian	Calcutta.
University of Dacca, The Librarian	Dacca.
University of Madras, The Registrar	Madras.
University of Rangoon, The Registrar	Rangoon.
U. P. Chief Conservator of Forests	Naini Tal.
Upton, T. E. T.	New Delhi.
U. S. Department of Agriculture, The Librarian	Washington, D. C.
Van Ingen, DeWet	Mysore.
Vaughan, Wm. (F.F.S.) (*Life Member*)	Europe.
Venning, Brigadier F.E.W.(C.B.E ,D.S.O.)(*Life Member*)	Multan.
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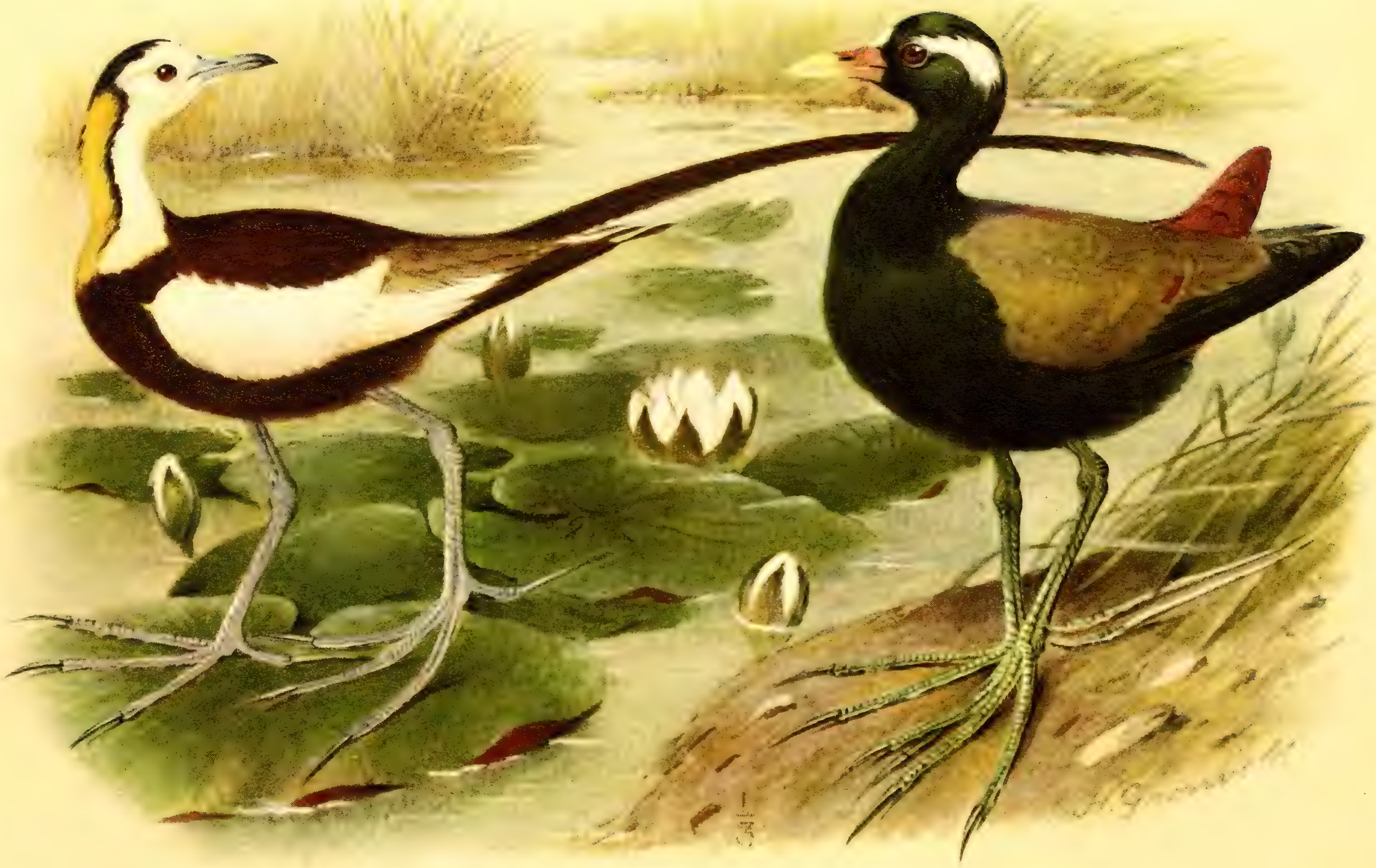

THE PHEASANT-TAILED JACANA.
Hydrophasianus chirurgus.
⅓ Nat. size.

THE BRONZE-WINGED JACANA.
Metopidius indicus.
⅓ Nat. size.

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THE GAME BIRDS OF THE INDIAN EMPIRE

BY

E. C. STUART BAKER, F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

VOL. V

THE WADERS AND OTHER SEMI-SPORTING BIRDS

PART IX

(*With a coloured plate*)

(*Continued from page 228 of this Volume*)

Suborder : JAÇANÆ

Characteristics those of the family Jaçanidæ.

Family : JAÇANIDÆ

This group of birds has hitherto been placed in the Order *Limicolæ* but Lowe has recently shown that they are really nearer the *Rallidæ*, a position in which the field naturalist would also place them without doubt. At the same time, many of their characteristics show an approach to the *Grues* and it may eventually be necessary to elevate these birds to the rank of an Order, *Jaçanæ*, between the *Grallæ* and *Limicolæ*.

Two genera of this family are found in India.

Key to Genera

A. A frontal lappet ; primaries not attenuated at the end	*Metopidius.*
B. No frontal lappet ; first and fourth primaries attenuated	*Hydrophasianus.*

Genus : Metopidius

Metopidius Wagler, Isis, 1832, col. 279.

Type, *Parra æna* Gav. = *Parra indica* Lath.

Head small ; bill moderately long, straight and compressed, the culmen curved at the tip ; a lappet at the base of the bill resting against the forehead and rounded behind ; tail short ; wing not rounded, the first and second primaries subequal and longest ; a tubercular spur on the carpal joint ; middle toe without claw longer than tarsus, hind claw excessively long ; tarsus transversely shielded before and behind.

Sexes alike but juvenile and adult plumage differing greatly, the latter acquired by a spring moult when the bird is a year old.

A single species.

Metopidius indicus

The Bronze-winged Jaçana

Parra indica Lath., Ind. Orn., ii, p. 765 (1790).

Metopidius indicus.—Blanf. and Oates, iv, p. 218.

Vernacular Names.—Dal-pipi, Jal-pipi, Karativa (Beng.) ; *Kattoi* (Purnea) ; *Bi* (Burma).

Description.—Feathers below the eye and a broad superciliary streak from the eye to the nape pure white ; remainder of head, neck, lower parts, axillaries and under wing-coverts black, glossed all over with deep green ; hind-neck glossed with purple-blue and then purple, the green-blue and purple grading into one another ; back, wing-coverts and innermost secondaries olive-bronze ; lower back, rump and upper tail-coverts chestnut with purple reflections ; greater wing-coverts, primaries and outer secondaries black, glossed with green on the outer webs ; tail and under tail-coverts chestnut ; vent and thigh-coverts dull brownish-black, sometimes extending on to the centre of the abdomen.

Colours of soft parts.—Iris brown ; bill greenish-yellow, tinged with red at the base and pure yellow at the tip ; frontal lappet or shield livid red ; legs and feet dull green.

Measurements.—Wing, ♂ 165 to 198 mm., ♀ 152 to 186 mm. ; tail 34 to 52 mm. ; tarsus 65 to 80 mm. ; culmen 31 to 39 mm. ; mid toe and claw 87 to 106 mm. The great differences in the extremes of size are not due to geographical variation.

Young birds have the crown and nape rufous-brown, darker on the forehead and centre of the crown ; short supercilium dull white ; hind-neck black glossed with green ; interscapulars black glossed with purple ; lower back and rump dull rufous barred with dusky brown, upper tail-coverts barred white and brown ; tail rufous with contour-bands of black: remaining upper plumage like that of the adult; lores dull rufous; ear-coverts grey, chin white, changing to pale rufous on the neck and breast; lower breast and abdomen sullied rufous-white; flanks brown, rufous posteriorly and barred with white.

Distribution.—Nearly all India, Burma, the Indo-Chinese countries, Malay States to Java, Sumatra and the Celebes. It is rare in the Southern Punjab and does not occur in the Northern Punjab, Sind nor in Western Rajputana.

Nidification.—The Bronze-winged Jaçana begins to think about domestic arrangements as soon as the rains show signs of breaking. With the advent of the first few showers, the birds start collecting materials for their rather insignificant little nests. These materials consist of a base of wet weeds, reeds, and stems of water lilies, upon which a flimsy lining of dry rushes and bits of dry weed are placed. Altogether the nest is so small and weak that it looks as if it could never support the weight of the eggs or chicks. This apparent flimsiness is however overcome by the nest being built on the tops of semi-submerged lotus leaves or water lily plants, so that though the base may be quite soaked through, the lining is usually fairly dry. The site selected for the nest is generally a swamp or marsh of some extent and the birds very seldom breed in small ponds or tanks, whilst on the other hand they sometimes make their nest in the middle of lakes, open except for the surface weeds and lilies which lie in patches here and there. Occasionally I have found them in quite small ponds and once in the district of Rungpur a pair took up their abode and made their nest in quite a small tank in my garden. Here I noticed the birds only worked at their nests for a couple of hours in the mornings and evenings and even then were very casual and slow in their proceedings, often stopping work to feed or loaf for a few minutes. Indeed the nest looked as if it might easily have been put together in an hour, though as a matter of fact the birds took four days to build it. It was of course a very inconspicuous nest, almost level with the water, and in colour the same as that of the lotus leaves on which it was built. Had I not seen the birds actually building the nest, it might easily have escaped my notice. In this nest the bird laid only four eggs but five are not uncommon and I have once or twice found six, whilst on one occasion Hume took seven. They are extraordinarily handsome eggs; the ground colour varying from light yellowish-stone or buff to a deep rufous or red-brown, whilst the whole surface of the egg is covered by numerous long and twisted lines of black, looking as if a child had attempted to write all over it. In shape the eggs are oval, very little compressed at the smaller end, the texture is very fine, strong and highly glossed and they are certainly amongst the most remarkable, as well as the most beautiful of birds' eggs. Eighty eggs average 36·4 × 25·1 mm.; maxima 39·5 × 27·0 mm.; minimum 33·8 × 34·9 and 35·4 × 22·0 mm. Under ordinary circumstances the Bronze-winged Jaçana is a very shy little bird and the hen sneaks off her nest long before the intruder has a chance of seeing her on it, but the two birds which bred in my garden became extremely tame and the little hen would sit on her nest within 30 yards of me without leaving, although all the time she kept her bright eyes fixed steadily upon me. Even when the tiny chicks were hatched, she was content merely to walk away into the reeds with them when I appeared. Before these birds began to build their nests I saw but few signs of courting or display. Occasionally the malebird in the early mornings and late evenings used to run rapidly backwards and forwards in front of the female with a little bit of weed in his mouth, bob two or three times in an excited fashion and then drop the weed and proceed with his feeding. Rarely the female would pick up the discarded bit and also make two or three little excited runs backwards and forwards, though as a rule she took not the slightest notice of the male bird's performance, continuing to feed as if he was not even present. Incubation, I believe, took fourteen days but I was away from home when the eggs were hatched, so cannot be certain. Nor can I say how long they took to acquire feathers for all four young ones were killed by vermin, probably rats, within a fortnight of their birth.

Habits.—The Bronze-winged Jaçana keeps for the most part to the larger lakes and swamps and where these are numerous and contain water throughout the year this Jaçana is common and resident but in those places where nearly all the water dries up during the hot weather, the birds move into the adjacent and wetter districts, though they are nowhere really migratory. They are essentially birds of the plains and are not found in the Himalayas or in the higher hills of Southern India. In preference they frequent stretches of water such as have reed and rush cover round the edges, whilst the centres are more or less covered with floating water plants and, above all, they seem to like best the great stretches of lotus plants, upon the broad leaves of which they can run with ease and comfort and at the same time have an ample supply of food. This consists in great part of insects and a tiny water snail which also frequents and feeds on the lotus leaves. In addition to this, the birds feed on small fish, crustacea, small worms, larvæ, etc. When feeding their actions are rather slow and deliberate, alternating with quick little runs hither and thither as they pursue insects on the move. When one has a specimen of this bird in hand, it seems impossible for its movements to be other than clumsy, the legs and feet being so enormous in proportion to the bird itself. This is not, however, the case and though its walk is slow and rail-like, it is distinctly graceful, its high action in no way giving the impression of awkwardness. Moreover, if frightened, it is capable of great speed, running over the floating vegetation with a velocity impossible to birds with smaller feet. On the wing it certainly loses much of its gracefulness. It flies slowly with rapid beating of the wings and with its enormous feet hanging down below and looking out of all proportion to the bird itself. They are rather crepuscular in their habits and feed mostly in the early mornings and evenings but where they are not interfered with they sometimes may be seen strutting about feeding during the hottest part of the day, whilst they are fond of lying down on the lotus leaves and basking in the sun. They have rather large range of low conversational notes and a very pleasant piping call used by both sexes to one another and to their young. The breeding note is a rather low guttural grunt or crake which seems to be uttered most often during the night.

The natives say that the flesh is good to eat and I have known some Englishmen say the same but the only bird I have ever tried was very dry and tasteless, though not fishy. They are certainly not worth shooting either from the point of view of food or of sport.

Genus : HYDROPHASIANUS

Hydrophasianus Wagler, Isis, 1832, Col. 279.

Type by orig. desig. *Parra chinensis* auct. = *P. chirurgus* Scopoli.

In this genus the bill is more slender than in *Metopidius* and there is no lappet ; the hind claw is shorter ; the first and fourth primaries are attenuated, the first into a barbless shaft terminating in a spatulate web and the fourth prolonged into an attenuated point ; The wing is furnished with a strong sharp spur at the bend. Sexes alike, both assuming a nuptial dress which is attained by a moult and not by a change of the plumage as was at one time supposed.

The female is rather larger than the male.

A single species.

HYDROPHASIANUS CHIRURGUS

The Pheasant-tailed Jaçana

Tringa chirurgus Scop. del Flor. et Faun., Insubr., ii, p. 92 (1786) (China).

Hydrophasianus chirurgus. Blanf. and Oates, iv. p. 219.

Vernacular Names—Peho, *Pihuya* (Hin,) ; *Surkal*, *Sakdal*, *Miwa*, *Dal-kukera*, *Bhepi*, *Jil-manjor*, *Chitra-Billai* (Beng. and Behar) ; *Balal Sauru*, *Newiya* (Ceylon) ; *Rani di-dao gophita* (Cachari).

Description—Breeding Plumage.—Head, throat and foreneck white ; a certain amount of black on the occiput ; back of neck pale, shining golden-yellow, edged with lateral black lines ; upper and lower plumage chocolate-brown ; blackish on the rump, upper tail-coverts and tail ; wing-coverts white, the primary covert with broad black, tips to the inner webs ; primaries black with increasingly white centres, the middle secondaries being pure white and the innermost like the back ; under wing-coverts and axillaries white.

Colours of soft parts.—Iris brown ; bill slaty-blue, paler at the tip ; legs and feet pale bluish-plumbeous.

Measurements.—Wing 182 to 242 mm. ; tail 145 (generally over 200) to 325 mm. ; tarsus 54 to 59 mm. ; culmen 25 to 29 mm.

Non-breeding plumage.—Supercilia white ; a line from behind this running down either side of the neck golden-yellow, a black line from the lores, through the eye and down below the yellow, expanding into a broad gorget across the breast ; remainder of upper plumage light hair-brown ; innermost and outermost wing-coverts white ; intermediate coverts light brown barred with white and narrow black lines ; quills as in Summer ; lower plumage pure white.

Colours of soft parts.—Iris pale yellow; bill yellow, the terminal half brown; legs and feet dull greenish to dull plumbeous.

Young birds have no yellow on the sides of the neck; the dark gorget is broken up with white; the crown is dull rufous-brown and the feathers of the upper parts are pale-edged.

Distribution.—Ceylon, all India and Burma, north to Kashmir, east to South China and south to the Philippines and Java. It has been recorded from Gilgit in the extreme north-west as well as from Panji.

Nidifiction.—The Pheasant-tailed Jaçana breeds throughout the plains of India and Burma, wherever there is a sufficiency of water and, unlike the last bird, it also breeds at considerable elevations in the Himalayas. It is very common on the Kashmir lakes up to at least 6,000 feet and the members of expeditions to the Abor and Mishmi Hills have also reported it from both of those districts. In North Cachar I found it breeding, though not regularly, on a tiny artificial reservoir surrounded by forest in the North Cachar Hills at some 4,000 feet, whilst in the Khasia Hills we more than once have found nests at about 5,500 feet, at a place where there is a little rice cultivation and a few small ponds.

It does not seem to mind much what kind of water it breeds in, so long as there is sufficient cover round about it and enough floating weed to give it support as it runs about. The nest is very much like that of the Bronze-winged Jaçana but is often very flimsy and small. I have seen a nest supported on lily leaves, which consisted of nothing more than a few scraps of rush blades and grass, the four eggs it contained resting almost directly on the lily leaf. Where the weeds are small and quite wet on the surface the nest is sometimes rather more substantial but never looks strong enough to contain the four eggs. In the larger lakes and swamps it is often placed right out in the open but it is never very conspicuous as it agrees too well with its surroundings. In small ponds and village tanks the nest is generally placed so that the floating weeds conceal it to some extent. The full clutch of eggs invariably numbers four and the colour ranges from a pale yellow-bronze or olive-brown to a deep chocolate-purple. The shell is rather thin and the texture fragile but the surface always carries a high gloss. Abnormally coloured eggs are not uncommon and these vary from almost white, pale grey or pale grey-green to the faintest yellow ochre. In shape the eggs are peg-top, the larger end often very flat, and they lie in the nest point to point, fitting very closely into a small compass. A hundred eggs average 37·8 × 27·6 mm.; maxima **39·9** × 27·1 and 36·1 × **29·0 mm.**; minima **34·5** × 28·9 and 34·6 × **26·0 mm.**

The breeding season commences at the end of June after the first rains have begun and fresh eggs may be found up to the middle of September. In Ceylon they breed from March to June whether nesting in the plains or in the big forest tanks at a considerable elevation in the hills. So far as I know, the female alone incubates but she leaves her nest, even when it contains eggs, for long periods during the heat of the day when the sun is hot enough to prevent their being chilled. Whilst it is raining, however, she sits very close and I have seen her squatting on her eggs entirely unprotected by any cover during torrents of rain. The wet seemed to incommode her in no way but every now and then she would get up and shake herself like a small dog, the wet drops off her oily plumage scattering in all directions.

Habits.—The habits of the Pheasant-tailed Jaçana do not differ greatly from those of the preceding species but whilst that bird seldom haunts village ponds, there are few pieces of water, however small, upon which a pair of the Pheasant-tailed Jaçana do not take up their abode. In every way they are much more confiding, friendly little birds than their cousins and they will even wander about happily on one side of a tank whilst the village washerman is busy at his work on the other side. In spite of its enormous feet and long tail this Jaçana is a most dainty little bird in all its actions except in flight. The Cacharis have given it the pretty, yet appropriate name of the Little White Water Princess, a name to which its white and black plumage and elegant actions fully entitle it. In flight it loses all its elegance and becomes a slow-flapping, ungainly little bird apparently much overweighted by the enormous feet which trail below it. Its food is both vegetarian and insectivorous and generally when feeding on the floating lilies and lotus plants it may be seen making little runs of a few paces from one place to another as it catches insects on the move. Then for a few moments it stops to pick up small water snails, etc., off the lily leaves or it thrusts head and shoulders deep into the water to get at some attractive morsel below the surface. It swims well and sits high on the water, with its long tail sufficiently raised to avoid getting wet. The ordinary note is a low mew which is like that of a kitten but it has a rather pleasant and musical pipe as well and I have heard a pair of birds uttering a little chuckling note when walking about together on the surface weeds of a village pond.

Both this and the last bird are difficult to keep in captivity, a great pity, as they would make most charming additions to any private water and would soon become very tame and fearless. Possibly the Bronze-winged Jaçana would not stand cold but the Pheasant-tailed Jaçana is tolerant of slight frosts and does not leave the hills for the plains in winter.

(*To be continued*)

REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY

BY

E. BLATTER, S.J., PH.D., F.L.S.

PART IX

GRAMINEÆ

BY

E. BLATTER and C. MCCANN

(Continued from page 243 of this Volume)

TRIBE IX. ZOYSIEÆ

74. TRACHYS, Pers. ; Cke. ii, 1013.

1. **Trachys mucronata**, Pers. Syn. i (1805), 85 ; Beauv. Agrost. 107, t. 21, f. 7 ; Hook. f. F.B.I. vii, 96 ; Cke. ii, 1014.—*T. muricata*, (*per errorem pro mucronata*) Steud. Syn. Gram. 112.—*Cenchrus muricatus*, Linn. Mant. 302.—*C. tripsaceus*, Herb. Linn. ex Munro in Journ. Linn. Soc. vi (1862), 55.—*Trachystachys geminata*, A. Dietr. Sp. Pl. ii, 16.—*Tripsachum distachyum*, Herb. Linn. ex Munro l.c.—*Panicum dimidiatum*, Burm. Fl. Ind. 25, t. 8, f. 3.—*P. squarrosum*, Retz. Obs. iv (1786), 15, t. 1 ; Roxb. Cor. Pl. iii, t. 206 ; Fl. Ind. i, 288.

Description : Cke. ii, 1014.

Locality : S. M. Country : Badami (Bhide !, Cooke, Woodrow) ; Gokak (Talbot !) ; Dharwar (Woodrow).

Distribution : W. Peninsula, Ceylon.

75. NAZIA, Adans. Fam. Pl. ii (1763), 581 ; Hitchcock Genera of Grass. Unit. St. in Unit. St. Dept. Agric. Bull. 772 (1920), 165.

(*Tragus*, Haller Stirp. Helv. ii (1768), 203 ; Cke. ii, 1014).

The type species is *Cenchrus racemosus*, Linn. and the genus *Nazia*, Adans. is based on this species. As to *Tragus*, Haller, this author, according to Hitchcock, cites pre-Linnaean writers who connect Tragus with *Cenchrus racemosus*, Linn.

Species 3.—Tropical regions of both hemispheres.

1. **Nazia racemosa**, Kuntze Rev. Gen. Pl. iii, 357 ; Hitchcock Genera of Grass. Unit. St. in Unit. St. Dept. Agric. Bull. 772 (1920), 165.—*Tragus racemosus*, Scop. Introd. Hist. Nat. 73 ; Desf. Fl. Atlant. ii, 386 ; Duthie Grass. N. W. Ind. 13, Indig. Fodd. Grass. t. 14, Fodd. Grass. N. Ind. 22 ; Hook. f. in. F. B. I. vii, 97 ; Cke. ii, 1014 ; Haines Bot. Bihar & Orissa (1924), 979.—*T. brevicaulis*, Boiss. Diag. Pl. Or. Ser. i, xiii, 44.—*Lappago racemosa*, Honck. Syn Pl. Germ. i, 440 ; Host. Gram. Austr. i, t. 36 ; Sibth. Fl. Graec. ii, t. 101 ; Reichb. Ic. Fl. Germ. i, t. 30 ; Thw. Enum. Pl. Zeyl. 362 ; Aitchis. Cat. Panjab Pl. 163 ; Benth. Fl. Austral. vii, 506 ; Miq. Fl. Ind Bat. iii, 473.—*L. biflora*, Roxb. Fl. Ind. i (1832), 281 ; Grah. Cat. 234.—*L. allena*, Dalz. & Gibs. 295 (*non* Spreng.).—*L. occidentalis*, Nees in Schimp. Pl. Arab. Fel. ed. ii, No. 793.—*Cenchrus racemosus*, Linn. Sp. Pl. 1049.—*C. linearis*, Lam. Fl. Franç. iii, 631.—*Phalaris muricata*, Forsk. Fl. Aeg.-Arab. 302.

Description : Cke. ii, 1014.

Locality : Sind : Tatta, Tombs (Blatter & McCann D679 !).—*Gujarat :* Ahmedabad, waste ground (Sedgwick !) ; Domas, near Surat (Graham) ; Rajkot, Kathiawar (Woodrow).—*Khandesh :* Bor, Tapti bank (Blatter & Hallberg 5467 !).—*Konkan :* Salsette (Graham).—*Deccan :* Poona (Woodrow !, Jacquemont 386) ; Chattarshinji Hill, Poona (Bhide !) ; Bijapur (Cooke, Woodrow).—*S. M. Country :* Dharwar (Sedgwick & Bell 4145 !) ; Mallapur Hill, Bagalkot (Paranjpe !) ; Gokak (Shevade !) ; Badami (Woodrow !).

Distribution : Most warm countries.

76. Latipes, Kunth.

1. **Latipes senegalensis**, Kunth Rev. Gram. i, (1829), 261, t. 42 ; Enum. Pl. i, 171, Suppl. 125 ; Duthie Grass. N. W. Ind. 13, Fodd. Grass. N. Ind. 22 ; Hook. f. in F.B.I. vii, 97 ; Cke. ii, 1015.—*Lappago Latipes*, Steud. Syn. Gram. 112.—*Tragus senegalensis*, J. Gay ex Kunth Enum. Pl. i, 171.

Description : Cke, ii, 1015.

Locality : Sind : (Woodrow !) ; Karachi (Burns !) ; 20 miles N. of Karachi (Woodrow) ; Jamadar ka Landa, near Karachi (Stocks 1186).

Distribution : Baluchistan, Arabia, Abyssinia, Senegal.

77. Perotis, Ait. ; Cke. ii, 1016.

Species 2 or 3.—Tropics of the Old World and subtropical Australia.

1. **Perotis latifolia**, Ait. Hort. Kew i (1789), 85 ; Beauv. Agrost. t. 4, f. 9, Roxb. Fl. Ind. i, 239 ; Grah. Cat. Bomb. Pl. 237 ; Dalz. & Gibs. Bomb. Fl. 296 ; Duthie Grass. N. W. Ind. 13 ; Miq. Fl. Ind. Bat. iii, 479 ; Hook. f. in F.B.I. vii, 98 ; Cke. ii, 1016 ; Haines Bot. Bihar & Orissa (1924), 978.—For synonyms see Hook. f. l.c.

Description : Cke. ii, 1016.

Locality : Gujarat : Baroda (Cooke) ; Surat (Lisboa) ; Domas near Surat (Dalzell & Gibson) ; Daman, on sand hill (Bhide !) ; Ahmedabad (Saxton 1052 !) ; Balsar (Herb. S. X. C. !).—*Konkan :* Juvem (McCann 4312 !) ; Versova (McCann 4204 !) ; Alibag, sandy shore (Ezekiel !) ; Bassein (Bhide !), Malwan (Woodrow).—*S. M. Country :* Mallapur Hill, Bagalkot (Paranjpe !) ; Gokak (Shevade !) ; Badami (Bhide !, Cooke, Woodrow) ; Londa (Bhiva !) ; Gokak Falls (Sedgwick !).—*Kanara :* Kalanudi (Sedgwick & Bell 4287 !) ; Karwar (Talbot 1068 !, McCann !) ; Honore (Talbot 1068 !).

Usually growing on sandy shores. It is easily recognized by its purplish squirrel-tail-like inflorescence.

Distribution : More or less throughout India, Ceylon, S. Africa.

78. Osterdamia, Neck. Elem. Bot. iii (1790), 218.

(Zoysia, Wild. (1801) ; Cke. ii, 1016).

Species about 10, tropical Asia to Australia and New Zealand, Mauritius ; in Japan alone there are 7 species (See : Honda Masaji Revisio Gram. Japoniæ i, in Bot. Mag. Tokyo 37 (1923), 113–124.

1. **Osterdamia Matrella**, O. Ktze. Rev.Gen. Pl. ii (1891), 781; Hitchcock Genera of Grass. Unit. St. in Unit. St. Dept. Agric. Bull. 772 (1920), 166.—*Agrostis matrella*, Linn. Mant. ii, 185 : Roxb. Fl. Ind. i, 317.—*Matrella juncea*, Pers. Syn. Pl. i (1805), 73.—*Zoysia pungens*, Willd. in Ges. Naturf. Fr. Neue Schrift. iii (1801), 441 ; Br. Prodr. x, 208 ; Beauv. Agrost. i, t. 4, f. 1 ; Miq. Fl. Ind. Bat. iii, 478 ; Hook. f. in F. B. I. vii, 99 ; Cke. ii, 1016 ; Haines Bot. Bihar & Orissa (1924), 979.

Description : Cke. ii, 1016.

Locality : Gujarat : Daman, on sand hills (Herb. Econ. Bot. !, Lisboa).—*Konkan :* Alibag, sandy shore (Ezekiel !) ; Juvem (McCann 4314 !) ; Bombay, Walkeshwar, seashore, rocks (Sabnis !) ; Marine Lines (Hallberg 9873 !) ; Versova, marsh (McCann 9875 !).—*Kanara :* Karwar (Talbot 1531 !, McCann !).

Distribution : Tropical Asia.

TRIBE X. SPOROBOLEÆ

79. SPOROBOLUS, R. Br. Fl. Nov. Holl. (1810), 169; Cke. ii, 1017.

Species about 95.—Warm regions of both hemispheres, most abundant in America.

Cooke describes 10 species. We retain all of them and add 3 others: *S. virginicus*, Kunth, *S. scabrifolius*, Bhide, and *S. tremulus*, Kunth.

A. Involucral glumes both shorter than the floral glume
  I. Stamens 2
    1. Culms 30–90 cm. high; panicle reaching 25 cm. ... ... 1. *S. diander.*
    2. Culms scarcely 15 cm. high; panicle reaching 20–25 cm. ... ... 2. *S. sindicus.*
  II. Stamens 3
    1. Panicle narrow, 12–20 mm. broad. Spikelets reaching 2·5 mm. long ... 3. *S. indicus.*
    2. Panicle reaching 7·5 cm. broad
      a. Panicle 30–45 cm. long. Spikelets 1 mm. long ... ... 4. *S. minutiflorus.*
      b. Panicle 10–15 cm. long. Spikelets 2 mm. long ... ... 5. *S. ioclados*

B. Lower involucral glume as long as the floral glume or nearly so. Panicle interrupted
  I. Spikelets 2·5 mm. long. Leaves very pale ... ... 6. *S. virginicus.*
  II. Spikelets 1·5 mm. long. Leaves glaucous. 7. *S. glaucifolius.*

C. Lower involucral glume much shorter than either of the two others
  I. Panicle contracted
    1. Perennials
      a. Margins of leaves smooth ... ... 8. *S. tremulus.*
      b. Margins of leaves serrulate ... ... 9. *S. orientalis.*
    2. Annual... ... ... 10. *S. piliferus.*
  II. Panicle effuse
    1. Spikelets 2·5 mm. long ... ... 11. *S. arabicus.*
    2. Spikelets 1–1·5 mm. long
      a. Floral glume ovate, acute ... ... 12. *S. scabrifolius.*
      b. Floral glume ovate-lanceolate, acuminate ... ... 13. *S. coromandelianus.*

1. **Sporobolus diander,** Beauv. Agrost. (1812), 26; Jacq. Eclog. Gram. t. 28; Link Enum. Hort. Reg. Berol. i, 87; Kunth Enum. Pl. i. 213; Griff. Notul. iii, 46, Ic. Pl. Asiat. t. 139, f. 85; Dalz. & Gibs. Bomb. Fl. 296; Aitchis. Cat. Panjab Pl. 165; Duthie Grass. N. W. Ind. 29; Fodd. Grass. N. Ind. 40, t. 63; Miq. Fl. Ind. Bat. iii, 375; Hook. f. in F.B.I. vii, 247; Cke. ii, 1017.—*Agrostis diandra*, Retz. Obs. v, 19; Roxb. Fl. Ind. i, 317.—*Vilfa erosa*, Trin. in Mem. Acad. Petersb. ser. vi, Sc. Nat. ii (1840), 86.—*V. Retzii*, Steud. Nom. ed. ii, ii, 768, Syn. Gram. 162.

Description: Cke. ii, 1017.

Locality: Sind: Jamesabad, fields (Sabnis B927 !).—*Gujarat*: Ahmedabad (Sedgwick !).—*Konkan:* Bombay (Blatter 5267 !).—*Deccan:* Deolali (Blatter 549 !); Khandala (McCann 5409 !); Chattarshinji Hill, Poona (Ezekiel !, Jacquemont 352); Katraj Ghat (Shevade !); Panchgani (Blatter & Hallberg B1318 !).—*S. M. Country:* Dharwar (Sedgwick 2658 !); Londa (Bhide !).—*Kanara:* Dandeli, 1,800 ft., rainfall 100 inches (Sedgwick & Bell 4221 !).

Distribution: India, Ceylon, Asia, tropical Australia.

2. **Sporobolus sindicus,** Stapf in Cooke Fl. Bomb. ii, 1018.

Description: Cke. l.c.

Locality: Sind: 20 miles from Karachi (Woodrow).—We have not seen this species.

Distribution: So far endemic.

3. **Sporobolus indicus,** R. Br. Prodr. (1810), 170 ; Link Hort. Reg. Berol. i, 87 ; Kunth Enum. Pl. i, 211 ; Duthie Fodd. Grass N. Ind. 49 ; Hook. f. in F.B.I. vii, 248 ; Trim. Fl. Ceyl. v, 261 ; Prain Beng. Pl. 1213 ; Cke. ii, 1018; Haines Bot. Bihar & Orissa (1924), 974.—*Agrostis indica,* Linn. Sp. Pl. 63.—*A. elongata,* Lamk. Ill. i, 142.—*A. tenacissima,* Jacq. Collect. i, 85, Ic. Rar. 3, t. 16 (*excl. syn.*).—*Sporobolus tenacissimus,* Beauv. Agrost. 26 ; Duthie Fodd. Grass. N. Ind. 49.- *Vilfa capensis & elongata,* Beauv. Agrost. 16 ; Trin. Gram. Diss. i, 154 ; Steud. Syn. Gram. 159.—*V. exilis,* Trin. in Mem. Acad. Petersb. ser. 6, Sc. Nat. ii (1840), 89.—*V. indica,* Trin. ex Steud. Nom. ed. ii, ii, 767, Syn. Gram. 162.—*V. tenacissima,* H.B. & K. Nov. Gen. & Sp. i, 138 ; Trin. Sp. Gram. Ic. t. 60.

Description : Cke. ii, 1018.

Locality : Deccan : Chattarshinji Hill, Poona (Ezekiel !) ; Lina Hill, Nasik Dist. (Blatter A59 !) ; Kolhapur (Woodrow).—*Kanara :* Castle Rock, 1,600 ft., rainfall 250 inches (Sedgwick 2851 !).

Distribution : Most warm countries.

4. **Sporobolus minutiflorus,** Link Hort. Reg. Berol. i (1827), 88 ; Kunth Enum. Pl. i, 214 ; Hook. f. in F.B.I. vii, 248 ; Cke. ii, 1019.—*Vilfa minutiflora,* Trin. Gram. Diss. i, 158 ; Steud. Syn. Gram. 158.—*V. capillaris,* W. & A. ex Wight Cat. No. 2036 (*non* Miq.).—*V. mangalorica,* Hochst. ex Miq. Anal. Bot. ii, 24 ; Steud. l.c. 158.—*V. tenuissima,* Schult. Mant. ii, 47.—*Panicum tenuissimum,* Mart. ex Schrank in Denkschr. Bot. Ger. Regensb. ii (1822), 26.

Description : Cke. ii, 1019.

Locality : Konkan : Bombay Island, very common (McCann 4296 !, 3635 !), Parel (Woodrow) ; Mulgaum (McCann 3660 !).—*Kanara :* Dandeli, 2000 ft., rainfall 100 inches (Sedgwick and Bell 4220 !) ; Kumpta (Chibber !).

Distribution : W. Peninsula.

5. **Sporobolus iociados,** Nees Fl. Afr. Austr. (1841), 161 ; Hook. f. in F.B.I. vii, 249 ; Cke. ii, 1019.

Description : Cke. l.c.

Locality : Sind (Stocks).

Distribution : S. Africa.

6. **Sporobolus virginicus,** Kunth Rev. Gram. i, 67, Enum. Pl. i, 210, Suppl. 167 ; Hook. f. in F.B.I. vii, 249.—*Agrostis virginica* Linn. Sp. Pl. 63 ; Labill. Pl. Nov. Holl. i, 20, t. 23.—*A. barbata,* Pers. Syn. i, 75.—*A. littoralis,* Lamk. Ill. 161.—*A. pungens,* Pursh Fl. Am. Sept. 64.—*Podosemum virginicum,* Link Enum. Hort. Berol. i, 85.—*Vilfa virginica,* Beauv. Agrost. 16 ; Trin. Diss. i, 155 ; Sp. Gram. Ic. t. 48 ; Baker Fl. Mauritius 449.—*V. barbata,* Beauv. l.c.—*V. littoralis,* Beauv. l.c.—*Sporobolus littoralis,* Kunth ll. cc. 68, 213.

Description : Perennial. Stems erect or ascending from a decumbent woody creeping base, branched, hard and often tortuous at the base, 15–30 cm. high. Leaves strict, close-set, distichous, erecto-patent, 2·5–7·5 cm. long or more, narrow and almost terete for the involute margins, pungent, very pale, glabrous or scaberulous above, striate ; sheaths terete, short or long ; ligule of long soft hairs. Panicle 2·5–10 cm. long, elongate, narrow, subspiciform, interrupted, very pale ; branches very short. Spikelets 2·5–2 mm. long, very shortly pedicelled, crowded. Glumes 3, all 1-nerved, keels glabrous or obscurely scabrid towards the tip. Involucral glumes oblong-lanceolate, acute, the lower shorter than the upper. Pale oblong, narrowly truncate. Grain broadly obovoid, with a pericarp loosened if moistened.

Locality : Gujarat : Porbandar (Chibber !). Chibber was the first to find this species on the shores of continental India.

Distribution : India, Ceylon, westward to Africa and America, eastward to Australia.

7. **Sporobolus glaucifolius,** Hochst. in Flora xxv, pt. 1 (1842), Beibl. 133 (*nomen nudum*) ; Hook. f. in F.B.I. vii, 250 ; Cke, ii, 1019.—*Vilfa glaucifolia,* Steud. Syn. Gram. 154.—*V. scabrifolia,* Hochst. ex Edgew. in Journ. Linn. Soc. vi (1862), 196 ; Aitchis. Cat. Panjab, Pl. 165.—*Agrostis barbata,* β, *sene.*

galensis, Pers. Syn. i, 76.—*A. littoralis* β, Lamk. iii, 161; Poir. Encycl. Suppl. i, 251.

Description : Cke. ii, 1019.

Locality : Sind : Mirpurkhas (Bhide !), fallow fields (Sabnis B1191 !) ; Jacobabad (Bhide !) ; Magarpir, near Karachi (Sabnis B224 !) ; Karachi (Woodrow 18).—*Gujarat :* Porbandar (Woodrow 21 !) ; road to Gogha (Chibber !) ; dry rice fields, Chandola, Ahmedabad (Sedgwick !).—*Konkan :* Bombay fore shore (Sedgwick 2568 !) ; Sion (McCann 3677 !).—*S. M. Country :* Khanapur, 2,500 ft., rainfall 60 inches (Sedgwick 3011 !).

Distribution : Panjab, Sind, tropical Africa.

8. **Sporobolus tremulus**, Kunth Rev. Gram. i, 67, Enum. Pl. i, 210, Suppl. 166 ; Hook. f. in F.B.I. vii, 250 ; Sedgwick & Saxton in Rec. Bot. Surv. India vi, 219 ; Haines Bot. Bihar & Orissa (1924), 974.—*Agrostis tremula*, Willd. Sp. Pl. i, 372 (*excl. syn.*).—*A. juncea*, Lamk. Encycl. i, 60, Ill. t. 41, f. 2.—*A. tenacissima*. Roxb. Fl. Ind. i, 316 (*excl. syn.*).—*Vilfa tremula*, Trin. Diss. i, 155.—*V. geniculata*, Nees ex Steud. Syn. Gram. 156.—*V. orientalis*, Wight Cat. No. 1745 (*partim*).—*Sporobolus geniculatus*, Nees ex Aitchis. Cat. Panjab Pl. 165.—*S. orientalis*, Trim. Cat. Ceyl. Pl. 108 (*non* Kth.).

Description : A small grass, 2·5–30 cm. high, erect or prostrate, wiry, strict, often tufted, from a hard, knotted, stoloniferous stock ; stolons 15–45 cm. long, stout or slender, leafy, flexuous. Leaves short, 1–5 cm. long, rigid, subulate or filiform, flat or convolute, pungent, narrowed from the usually hairy base to the tip, margins smooth. Ligule a few hairs. Panicle narrow, 2·5–10 cm. long, subspiciform sometimes longer, flexuous and interrupted, with erect branches, rarely a few spreading. Spikelets crowded, 1–5 mm. long, articulate on very short pedicels half their own length or less, very pale ; rhachilla readily disarticulate above the lowest glumes and these also separately falling. Glumes all 1-nerved. Lower involucral glume about ¾ of the floral glume, lanceolate ; upper involucral glume and floral glume subequal. Pale as long as its glume. Stamens 3. Grain oblong.

Locality : Gujarat : Sides of the Chandola Tank which are submerged in the monsoon (Sedgwick !).—*S. M. Country :* Kunnur, margins of tanks, 2,000 ft., rainfall 35 inches (Sedgwick & Bell 4936 !) ; Marrikop, margins of tanks, W. of Dharwar, 1,800 ft., rainfall 35 inches (Sedgwick & Bell 4495 !) ; Ranibennur, grassy plains near water (Bhide !).

Distribution : India, Ceylon, Burma, Tonkin, Cambodia.

9. **Sporobolus orientalis**, Kunth Enum. Pl. i (1833), 211 ; Dalz. & Gibs. Bomb. Fl. 295 ; Hook. f. in F.B.I. vii, 251 ; Cke. ii, 1020 ; Duthie Fodd. Grass. N. Ind. 49 ; Trim. Fl. Ceyl. v, 263.—*Agrostis orientalis*, Nees Agrost. Bras. 393 (*excl. syn.* Roxb.).—*A tenacissima*, Linn. f. Suppl. 107 (*excl. syn.* Jacq.).—*A. elongata*, Roth Nov. Sp. Pl. 41.—*Vilfa orientalis*, Nees ex Trin. in Mem. Acad. Petersb. ser. vi. Sc. Nat. ii (1840), 65 ; Steud. Syn. Gram. 156.—*V. diandra*, Trin. Diss. i, 154 (*excl. syn.* Retz.).—*Sporobolus humifusus*, Trim. Cat. Ceyl. Pl. 108 (*non* Kunth).

Description : Cke. ii, 1020.

Locality : Gujarat : Prantij Taluka, low grounds liable to inundation (Sedgwick !) ; Karie Roa, Cutch (Blatter 3771 !) ; Umrat, on salt land (Woodrow !).—*Konkan :* Bassein (McCann 4481 !).—*Kanara :* Karwar, borders of rice fields (Talbot 1531 !).

Distribution : Punjab, W. Peninsula, Ceylon.

10. **Sporobolus piliferus**, Kunth Enum. Pl. i (1883), 211 ; Hook. f. in F.B.I. vii, 251 ; Cke. ii, 1020.—*Vilfa pilifera*, Trin. Diss. i, 157, ii, 23, Sp. Gram. Ic. t. 58.—*Sporobolus ciliatus*, Munro in Herb. Ind. Or. Hook. f. & T. ex Hook f. in F.B.I. vii, 251: Duthie Grass. N. W. Ind. 29 (*non Vilfa ciliata*, Presl.).—*Triachyrum nilagiricum*, Steud. in Hohen. Pl. Ind. Or. no. 931.

Description : Cke. ii, 1020.

Locality : Deccan : Panchgani, Tableland, 4,300 ft., rainfall 60 inches (Sedgwick & Bell 4693 !, Blatter & Hallberg B1319 !, B1320 !, McCann !).—*S. M. Country :* Dharwar (Bhide !) ; Belgaum (Ritchie 836).

Distribution : W. Himalaya, Khasia Hills, Nilgiris, W. Peninsula, Malacca.

11. **Sporobolus arabicus,** Boiss. Diagn. Pl. Or. ser. i, xiii, 47 ; Hook. f. in F.B.I., vii, 252 ; Cke. ii, 1020.—*S. pallidus*, Boiss. Fl. Or. v, 514 (*non* Lindl.) ; Aitchis. Cat. Panjab Pl. 165 (*excl. syn.*).—*Vilfa pallida*, Nees ex Trin. in Mem. Acad. Petersb. ser. vi, Sc. Nat. ii (1840), 62 ; Steud. Syn. Gram. 155.—*V. arabica*, Steud. l.c. 241.

Hook f. calls the synonymy of this plant a perplexing one, 'owing to the double use of the specific name *pallidus*, and to the fact of *Vilfa* being now regarded as a synonym of *Sporobolus*. This name (*pallidus*) was applied by Nees in 1840 to the Arabian plant described above, under *Vilfa*; and by Lindley in 1848 to a very different Australian one, under *Sporobolus*. Bentham (*Fl. Austral.* vii, 623) assuming that Nees had referred his plant to *Sporobolus*, renamed Lindley's *S. Lindleyi*. Lastly, Boissier, when he founded his *S. arabicus*, was not aware that it was Trinius's *Vilfa pallida*, which he erroneously cites in Fl. Orient., under *Sporobolus pallidus*, Trin. In this case the proper course appears to me to be to retain the name *Sp. pallidus*, Lindl., for the Australian plant, and *Sp. arabicus*, Boiss., for the Arabian and Indian.' Personally we are inclined to call this species *S. pallidus*, Boiss., as *Vilfa pallida*, Nees is the oldest name for the Indo-Arabian species.

Description : Cke. ii, 1020.

Locality : Sind : (Burns !) ; Laki (Bhide !) ; Mirpur Sakro (Blatter & McCann D672 !, D677 !, D678 !) ; Gharo (Blatter & McCann D673 !, D676 !) ; Tatta (Blatter & McCann D674 !, D675 !) ; Jamadar ka Landa near Karachi (Stocks 663) ; Karachi (Woodrow) ; between Karachi and Magar Peer (Wykeham Perry).

Distribution : Punjab, Waziristan, Rajputana Desert, Afghanistan, Baluchistan, Arabia.

12. **Sporobolus scabrifolius,** Bhide in Journ. & Proc. As. Soc. Beng. new. ser. viii (1912), 312, pl. xxv.

Description : Stems erect, 20–75 cm. high. Nodes glabrous. Leaves 2·5—12 cm. long, 3–9 mm. broad, lanceolate, rounded or subcordate at the base, hairy on both surfaces with bulbous based hairs, margins slightly thickened and spinulosely serrulate ; sheaths glabrous ; ligule a fringe of hairs. Panicle 7·5–17·5 cm. long, 2·5–9 cm. diam. ; branches whorled or fascicled, a few solitary ones or twins intervening. Spikelets about 1 mm. long. Glumes 3, involucral ones empty, ovate, acute, membranous, 1-nerved, the lower one ⅔ the size of the upper ; flowering glume just a little shorter than the upper involucral, ovate, acute, membranous, 1-nerved, paleate, bisexual ; pale shorter than the glume. Stamens 3 ; styles 2 ; stigmas plumose. Grain rounded, slightly beaked at the extremities ; lodicules minute.

Locality : S. M. Country : Ranibennur (Bhide !) ; Haveri (Talbot 2176 !).

Distribution : So far endemic.

13. **Sporobolus coromandelianus,** Link. Hort. Reg. Berol. i (1827), 89 (*in nota*). Kunth Rev. Gram. i (1829), 68 ; Dalz. & Gibs. Bomb. Fl. 296 ; Hook. f. in F.B.I. vii, 252 ; Cke. ii, 1021 ; Haines Bot. Bihar & Orissa (1924), 975.—*Agrostis coromandeliana*, Retz. Obs. iv, 19 ; Vahl. Symb. i, 10 ; Roxb. Fl. Ind i, 316.—*A. indica*, Forsk. Fl. Aeg.—Arab. 104.—*Vilfa coromandeliana*, Beauv. Agrost. 15 ; Trin. Sp. Gram. Ic. t 11 (*omittens glumam involucri inferiorem*) ; Steud. Syn. Gram. 153.—*V. commutata*, Trin. Diss. i, 156.—*V. discospora*, Trin. in Mem. Acad. Petersb. ser. vi, Sc. Nat. ii (1841), 59.—*V. Roxburghii*, Nees ex Trin. l.c.—*V. Roxburghiana*, Nees ex Wight Cat. No. 1742 ; Steud. Nom. ed. ii, ii, 59.—*Sporobolus commutatus*, Kunth Enum. i. 214 ; Miq. Fl. Ind. Bat. iii, 376 (*excl. syn. pulchello*) ; Boiss. Fl. Or. v (1884), 513 ; Aitchis. Cat. Panjab Pl. 165 ; Duthie Grass. N. W. Ind. 29.—*S. discosporus*, Nees Fl. Afr. Austr. 158.—*Triachyrum cordofanum*, Hochst. ex Steud. Syn. Gram. 176.

Description : Cke. ii, 1021.

Locality : Sind : Jamadar ka Landa near Karachi (Stocks).—*Gujarat :* Shady places at Dhansura Madasa-Petha (Sedgwick !).—*Khandesh :* Bor, Bori River (Blatter & Hallberg 4426 !)—*Konkan :* Kennedy Seaface, Bombay

(Sabnis 4295 !) ; Bombay (Law).—*Deccan :* Poona, College Farm (Khomne !) ; Gungapur (Blatter A56 !).—*S. M. Country :* Dharwar, 2,400 ft., rainfall 34 inches (Sedgwick 2832 !).

Distribution : Punjab, Orissa, Burma, W. Peninsula, Ceylon, Afghanistan, Africa.

TRIBE XI. ERAGROSTEÆ

80. DESMOSTACHYA, Stapf. in Haines Bot. Bihar and Orissa (1924), 962.

(*Eragrostis*, Beauv., *partim*).

This genus agrees with *Eragrostis*, Beauv., except in the following points : Spikelets very closely packed, imbricate, laterally very much compressed, secund, sessile and articulate on the very short densely crowded branchlets of a tall narrow racemiform panicle, acute and deciduous ; rhachilla subarticulate.

Species 1.—India to Syria and N. Africa.

1. **Desmostachya bipinnata,** Stapf in Fl. Cap. vii, 632 —*Briza bipinnata*, Linn. Syst. Nat. x, 875.—*Uniola bipinnata*, Linn. Sp. Pl. ed. ii, 104.—*Leptochloa bipinnata*, Hochst. in Flora xxxviii (1855), 422.—*Eragrostis cynosuroides*, Beauv. Agrost. 71, 162 ; Steud. Syn. Gram. 264 ; Wight Cat. No. 1774, 1774b ; Trin. in Mem. Acad. Petersb. ser. vi, i (1831), 415 ; Dalz. and Gibs. Bomb. Fl. 298 ; Aitchis. Cat. Panjab Pl. 169 ; Duthie Grass. N. W. Ind. 37, Fodd. Grass. N. Ind. 62, t. 40 ; Boiss. Fl. Or. v, 583 ; Lisboa in Journ. Bomb. Nat. Hist. Soc. vii (1893), 387 ; Hook. f. in F. B. I. vii 324 ; Cke. ii, 1028 ; Prain Beng. Pl. 1221.—*Poa cynosuroides*, Retz. Obs. fasc. iv, (1786), 20 ; Roxb. Fl. Ind. i, 333 ; Del. Fl. d'Egypt 159, t. 10 ; Grah. Cat. Bomb. Pl. 236 ; Kunth Enum. Pl. i, 227.—*Desmostachya cynosuroides*, Stapf in Haines Bot. Bihar and Orissa (1924), 962 ; Blatt., McCann and Sabnis in Journ. Ind. Bot. vi (1927), 76.—*Cynosurus durus*, Forsk. Fl. Aegypt.—Arab. 71.

Description : Cke. ii, 1028 (under *Eragrostis*).

Locality : Sind : Jacobabad (Bhide !) ; Hyderabad (Bhide !, Woodrow) ; Sukkur (Sabnis B550 !, Bhide !) ; Miani forest, Hyderabad (Bhide !) ; Larkana (Sabnis B100 !) ; Sehwan to Laki, foot of hills (Sabnis B66 !) ; Sehwan, sand dunes (Sabnis B674 !) ; Sita Road (Sabnis B360 !) ; Khairpur Mirs, forest (Sabnis B328 !) ; Phuleli Canal, on banks, at Hyderabad (Sabnis B181 !) ; Sanghar (Sabnis B895 !) ; Pad-Idan (Sabnis B517 !) ; Ghulamalla, fields (Blatter and McCann D643 !) ; Mirpur Sakro (Blatter and McCann D644 !, D646 !, D647 !) ; Gharo (Blatter and McCann D645 !, D648 !).—*Cutch :* (Blatter !).—*Gujarat :* Surat (Gammie !) ; Nadiad Farm (Supt. of Farm !) ; road to Lasundra (Chibber !) ; Charodi (Gammie 16526 !) ; Mandvi, Kathiawar (Woodrow).—*Konkan :* Palghar, Mahim (Ryan 2189) ; Bassein (Patwardhan !); Dahana, Thana Dist. (Burns !).—*Deccan :* Nasik (Lisboa).

Distribution : India, Syria, Egypt, Nubia.

81. ERAGROSTIS, Beauv. Ess. Agrost. (1812), 70, pl. 14.

f. 11 ; Cke. ii, 1021.

[1] Hitchcock ascribes the genus to Host because Host was the first to describe a species of *Erogrostis* (Gram. Austr. 4 (1809), 14, pl. 24). Host, however, did not give a diagnosis of the genus and so we retain Beauvois who first diagnosed the genus, l.c.

Species more than 100.—Tropical and temperate regions.

Cooke describes 15 species Of these *Eragrostis cynosuroides*, Beauv. has been put under *Desmostachya* above. The other species are being retained, with the exception that *E. tenella*, var. *viscosa*, Stapf is considered as a distinct species (*E. viscosa*). Of two species the names had to be changed viz. *E. amabilis* is here called *E. unioloides*, and *E. maior* goes under the name of *E. Eragrostis*. *E. papposa* and E. brachyphylla are new to the Presidency.

Key, after Cooke.

A. Spikelets panicled.

AA. Rhachilla of spikelets more or less jointed and breaking up from above downwards

I. Panicle spiciform, compact, 5–7·5 cm. by 8 mm.; rhachis bearded at the nodes; margins of flowering glumes ciliate ... 1. *E. ciliata.*

II. Panicle open or more or less contracted; margins of flowering glumes not ciliate

1. Spikelets 5 mm. long; panicle large, lax, thyrsiform, 20–50 by 10–15 cm. ... 2. *E. aspera.*

2. Spikelets 2·5 mm. long; panicle short, compact, cylindric, 12–40 mm. long. 3. *E. ciliaris.*

3. Spikelets 2·5–4 mm. long; panicles 5–20 cm. long

a. Grain ovoid. Stamens 3

aa. Not sweet-scented ... ... 4. *E. tenella.*

bb. Sweet-scented ... ... 5. *E. viscosa.*

b. Grain obovoid. Stamens 2 ... 6. *E. interrupta.*

BB. Rhachilla of spikelets tough, persistent; flowering glumes falling away from its base upwards

I. Spikelets flat, ovate-elliptic or oblong; lateral nerves of flowering glumes very prominent, straight, almost percurrent; pales deciduous with their glumes ... 7. *E. unioloides.*

II. Spikelets less compressed, linear or linear-oblong; lateral nerves less prominent. When spikelet compressed or lateral nerves prominent, then with persistent pales

1. Spikelets more or less fascicled on the primary or secondary branches or shortly pedicellate in narrow racemes

aa. Leaves glaucous; grain oblong. 8. *E. gangetica.*

bb. Leaves not glaucous; grain globose or nearly so ... 9. *E. stenophylla.*

2. Spikelets not fascicled; long pedicellate, more or less divaricate when ripe

a. Leaf-margins glandular

aa. Lower involucral glume 1–3-nerved; upper 3-nerved ... 10. *E. Eragrostis.*

bb. Both involucral glumes 1-nerved ... ... 11. *E. minor.*

b. Leaf-margins eglandular; involucral glumes 1-nerved

aa. Spikelets versatile, 2·5 cm. long or longer, narrowly linear; branches of panicle solitary... 12. *E. tremula.*

bb. Spikelets small, 4 mm. long or less

§ Mouth of leaf-sheath naked. 13. *E. tenuifolia.*

§§ Mouth of leaf-sheath bearded

† Perennial. Grain obovoid. 14. *E. papposa.*

†† Annual. Grain ellipsoid ... 15. *E. pilosa.*

B. Spikelets distichously spreading, secund, in a long, simple terminal spike

1. Keels of pale distinctly winged ... ... 16. *E. bifaria.*

2. Keels of pale not winged ... ... 17. *E. brachyphylla.*

1. **Eragrostis ciliata,** Nees Agrost. Bras. (1829), 512, Obs. 1 (*nomen nudum*); Wight Cat. No. 1788; Steud. Syn. Gram. 265; Dalz. and Gibs. Bomb. Fl. 298; Hook. f. in F. B. I. vii, 313; Cke. ii, 1022; Haines Bot. Bihar and Orissa (1924),

956.—*E. rupestris*, Steud. l. c.—*Poa ciliata*, Roxb. Fl. Ind. i, 334.—*P. rupestris*, Roth. Nov. Pl. Sp. 71.

Description : Cke. ii, 1022.

Locality : Gujarat : Domas, near Surat (Dalz. and Gibs.).—We have never come across this species.

Distribution : India, Cochin-China.

2. **Eragrostis aspera**, Nees Fl. Afr. Austr. (1841). 408 ; Lisboa in Journ., Bomb. Nat. Hist. Soc. vii (1893), 386 ; Hook. f. in F. B. I. vii, 314 ; Cke. ii, 1023.—*E. paniculata*, Steud. Syn. Gram. 278.—*Poa paniculata*, Roxb. Fl. Ind. i, 340. —*P. aspera*, Jacq. Hort.Vindob. iii, 32.

Description : Cke. ii, 1023.

Locality : Konkan : (Lisboa !).—*S. M. Country :* Hubli, in water hole, 2,500 ft., rainfall 30 inches ; (Sedgwick & Bell 4230 !) in a small tank near Dharwar, 2,500 ft., rainfall 34 inches (Sedgwick 1814 !) ; common in the water holes in the Naval Tract (Sedgwick).—*N. Kanara :* (Lisboa !).

Distribution : W. Peninsula, S. India, Ceylon, tropical and S. Africa, Isle of France.

3. **Eragrostis ciliaris**, Link Hort. Reg. Berol. i (1827), 192 ; Boiss. Fl. Or. v, 582 ; Baker Fl. Maurit. 456 ; Duthie Grass. N. W. Ind. 37, Fodd. Grass. N. Ind. 62 ; Aitchis. Cat. Panjab Pl. 169 ; Lisboa in Journ. Bomb. Nat. Hist. Soc. vii (1893), 380 ; Hook. f. in F. B. I. vii, 314 ; Cke. ii, 1023.—*Poa ciliaris*, Linn. Sp. Pl. 102.—*Eragrostis lobata*, Trin. in Mem. Acad. Petersb. ser. vi, i (1831), 396.—*E. lepida*, Hochst. ex A. Rich. Tent. Fl. Abyss. ii, 424.—*E. plumosa*, Boiss. Fl. Or. v, 582 (*excl. syn*).—*E. pulchella*, Parl. in Hook. Niger Fl. 186.—*E. arabica*, Jaub. & Spach Ill. Pl. Or. iv, 31, t. 322.—*Megastachya ciliaris*, Beauv. Agrost. 74.

Stapf (in Hook. f. F. B. I. l. c.) distinguishes 2 varieties :—

a. var. *ciliaris proper*, Stapf. Panicle spiciform, more or less lobed or interrupted.

b. var. *brachystachya*, Boiss. Fl. Or. v, 582. Panicle short, compact, cylindric.

In our opinion the many intermediate forms make it practically impossible to keep up this varietal distinction. The above synonymy and the following description are such as to include both varieties.

Description : Annual. Stem 15-60 cm. high, procumbent below and geniculately ascending, slender, glabrous, smooth. Leaves very narrow, flat, tapering to a fine point ; sheaths striate, usually bearded at the mouth with long hairs ; ligule a fringe of short hairs. Panicle 1–15 cm. long, spiciform, more or less lobed or interrupted, or short, compact and cylindric, appearing hairy from the long cilia of the pales ; branches very short, divided from the base, glabrous ; nodes of glabrous rhachis naked ; pedicels very short, glabrous. Spikelets 2·5 mm. long and broad, crowded, 6-12-flowered, strongly compressed, very pale ; rhachilla breaking up. Involucral glumes subequal, ovate-lanceolate, acute, 1·5 mm. long. Floral glumes about 1 mm. long, oblong, subtruncate, mucronulate, spreading, lateral nerves submarginal. Pales equal to their glumes and falling with them, the keels with long rigid cilia. Stamens 3 ; anthers very short. Grain elongate-ovoid, about 0·5 mm. long.

Locality : Sind : Karachi (Burns !) ; Jamadar ka Landa, near Karachi (Stocks) ; Mirpurkhas (Sabnis B1175 !) ; Mirpurkhas Farm, Mankad (Herb. Econ. Bot. !) ; Jamesabad, in fields (Sabnis B1109 !) ; Nasarpur, clayey soil (Sabnis B1058 !) ; Sanghar (Sabnis B757 !) ; Tatta (Blatter & McCann D649 !).—*Cutch :* Bhuj Hill (Blatter !).—*Gujarat :* Baroda (Woodrow) ; Domas, near Surat (Bhide !) ; Porbander (Bhide !) ; Nadiad (Chibber !) ; Broach (Woodrow !) ; Sungiri (Gammie 16553 !) ; Perim Isl., Gulf of Cambay (Blatter !).—*Khandesh :* Taner, Tapti bank (Blatter & Hallberg 5166 !) ; Nim, Tapti bed (Blatter & Hallberg 5400 !) ; Tapti Isl. near Bor, on sand and mud (Blatter & Hallberg 4394 !) ; Bor, Bori River (Blatter & Hallberg 4423 !); Amalner, Bori River (Blatter & Hallberg 5114 !).—*Konkan :* St. Xavier's College, compound (McCann 4527 ! 4596 !) ; Alibag, sandy shore Ezekiel !).—*Deccan :* Trimbak, Nasik Dist. (Chibber !).—*Kanara :* Honavar (McCann !).

Distribution : India, Arabia, tropical Africa and America.

4. **Eragrostis tenella,** P. Beauv. ex Roem. & Schult. Syst. ii (1817), 576 ; Stapl in Hook. f. F. B. I. vii, 315 ; Cke. ii, 1023.—*Poa amabilis*, Linn. Sp. Pl. ed. i (1753), 68.— *Poa tenella*, Linn. Sp. Pl. ed. i (1753), 69.

A. Camus in Lecomte's Flore Général de l'Indo-Chine has adopted the name *Eragrostis amabilis* for this species. Mr. Hubbard of Kew has informed us that, according to the Vienna Rules of nomenclature (Art. 46) this does not seem to be correct. *Poa amabilis*, Linn. is the same as *Poa tenella*, Linn., and *Eragrostis tenella*, P. Beauv. ex Roem. & Schult. is based on *Poa tenella*, Linn. Apparently Stapf (in Hook. f. F. B. I. vii, 315) was the first to unite the two species ; as the name first used when the species were united takes precedence over the other, we have to retain the name *E. tenella*, P. Beauv.

Description : Usually a small, very elegant and slender annual grass, very variable, rarely 45 cm. high. Stems many, slender, densely tufted. Leaves slender, narrow, acuminate, attaining 12 cm. by 5 mm., usually much less ; sheaths long-ciliate near the mouth. Panicles decompound, excessively branched 2–8 in. long, contracted or spreading, pale green or purplish, oblong-ovate or cylindric, never with the long interrupted rhachis and pseudo-verticillate branches of *E. interrupta*. Spikelets innumerable, minute to small on capillary brrnchlets and pedicels, 1-4 mm. by 1 mm. or less, not strongly compressed, 3–9-flowered. Involucral glumes subequal or unequal. Flowering glumes oblique, not mucronate, lateral nerves remote from the margins ; keels of pale usually obscurely ciliate. Stamens 3. Grain broadly ovoid, pale brown, polished.

Var. plumosa, Stapf in Hook. f. F.B.I. vii, 315 ; Cke. ii, 1024 ; Haines Bot. Bihar & Orissa (1922) 957.—*Eragrostis plumosa*, Link. Enum. Hort. Berol. i. (1827), 192 (*non* Boiss.) ; Duthie Grass. N. W. Ind. 38, Fodd. Grass. N. Ind. 64, t. 38, 77 ; Aitchis. Cat. Panjab Pl. 170 ; Lisboa in Journ. Bomb. Nat. Hist. Soc. vi (1893), 385.— *Poa plumosa*, Retz. Obs. iv, 20 ; Kunth Enum. Pl. i, 338; Roxb. Fl. Ind. i, 337.—*P. tenella*, Linn. Sp. Pl. ed. i, (1753), 69 : Burm. Fl. Zeyl. t. 47, f. 3 ; Retz. Obs. V, 19.—*Eragrostis tenella*, P. Beauv. l. c.—*P. despiciens*, Link. Enum. Hort. Berol. i, 88.—*Eragrostis despiciens*, Schult. Mant. ii, 318.

Description : Stems tufted, sometimes reaching 40 cm. high and more, and as well as the panicle eglandular. Panicle delicate, open, often flexuous ; branches capillary, rhachis bearded at the nodes ; pedicels distinct, often long. Spikelets 1·2–4 mm. long, 3–9-flowered, rhachilla subarticulate. Involucral glumes unequal, the lower distinctly shorter than the upper. Floral glumes less than 1 mm. long. Keels of the pale pectinately ciliate with long hairs. Anthers minute. Grain ovoid, less than 0·5 mm. long.

Locality : Sind : Mirpurkhas, on banks of dry watercourse (Sabnis B1023!),—*Gujarat :* Surat (Bhide !, Woodrow),—*Khandesh :* Bor, Tapti Island, sandy mud (Blatter & Hallberg 4395 !) ; Umalla, Tapti bank (Blatter & Hallberg 5230 !) ; Chanseli (McCann 9978 !).—*Konkan :* Common (Lisboa) ; Byculla, common in Bombay Island (McCann A1 ; Uran (Hallberg & McCann 5131 !, 5124 !).—*Deccan :* Sholapur (D'Almeida 9977 !) ; Poona (Cooke, Woodrow).—*S.M. Country :* Dharwar, 2,400 ft., rainfall 34 inches (Sedgwick 2830 !) ; Yelvigi, 1,800 ft., rainfall 30 inches (Sedgwick 2035 !) ; Badami (Bhide !) ; Gokak (Shevade !).—*Kanara :* Halyal (Talbot 2383 !).

Distribution : Throughout India and Ceylon.

Var. riparia, Stapf in Hook. f. F.B I. vii, 315 ; Cke. i, 1024.

Cooke included this variety on the authority of Graham (Cat. Bomb. Pl. p. 236, under *Poa tenella*). Graham does not give any locality ; Cooke has not seen any specimen from the Presidency and we have not found it anywhere in our area. We, therefore, drop this variety.

5. **Eragrostis viscosa**, Trin. in Mem. Acad. Petersb. ser. 6, i (1831), 397 ; Dalz, & Gibs. 298 ; Lisboa in Journ. Bomb. Nat. Hist. Soc. vii (1893), 386 ; Haines Bot. Bihar & Orissa (1922), 957.—*Poa viscosa*, Retz. Obs. iv (1786), 20; Roxb. Fl. Ind. i, 336 ; Grah. Cat. Bomb. Pl. 236 ; Kunth Enum. Pl. i, 336.—*Eragrostis tenella* var. *viscosa*, Stapf in Hook. f. F.B.I. vii, 315 ! Cke. ii, 1024.

Description : A tufted, sweet-scented-grass, 15–40 cm high, the panicles occupying the greater part of the plant. Stem and rhachis of panicle, pedicels and glumes with scattered microscopic glands, Leaves mostly convolute, erecto-patent, 2·5-3-5 cm. long with rigid tips, base and mouth of sheath with very long cilia. Panicles dense, cylindric or oblong, 7-13 cm. long and up to 3·5 cm. broad. Branches very numerous, more or less spreading, equal, sometimes opposite or 2-nate, but never in interrupted whorls as in *E. interrupta* ; rhachis usually glabrous, rarely obscurely bearded at the nodes. Spikelets 5-20-flowered, often purplish, usually about 3 mm. long ; rhachilla readily breaking up. Involucral glumes nearly equal or the lower very slightly shorter than the upper. Floral glumes broadly ellipsoid, obtuse or rounded, with the keel minutely scaberulous. Pale nearly as long as the glume, rigidly ciliate on the keels. Grain pale brown, polished, about 0·5 mm. long.

Locality: Gujarat : Junagad, Kathiawar (Blatter 3282 !, 3791 !).–*Khandesh:* Bor, Bori River (Blatter & Hallberg 4430 !) ; Amalner, Bori River (Blatter & Hallberg 5113!) ; Nim, Tapti bank (Blatter & Hallberg 3829 !) ; Dadgaum (McCann All !).—*Konkan :* Malabar Hill, Bambay.—*Deccan :* Khandala ; Panchgani (Blatter & Hallberg B1280 !).—*S. M. Cuntry :* Dastikop fields, 2,500 ft., rainfall 35 inches (Sedgwick & Bell 1898 !).—*Kanara :* Sulgeri, 500 ft., rainfall 200 inches (Sedgwick & Bell 4250 !) ; Birchy (Talbot 2102 !).

Distribution : From the Gangetic Plain southward, Ceylon, tropical and S. Africa.

6. **Eragrostis interrupta**, Beauv. Agrost. (1812), 71 (*non* Roem. & Schult. *neque* Trin.) ; Stapf in Hook. f. F.B.I. vii, 316 ; Cke. ii, 1024 ; Haines Bot. Bihar & Orissa (1924), 957.—*Poa interrupta*, Lamk. iii, i, 185 ; Poir. Encycl. v, 87 ; Heyne ex Roth Nov. Sp. 67 ; Koen. ex Roxb. Fl. Ind. i, 335.—*Poa Kœnigii*, Kunth Enum. Pl. i, 346.–*Eragrostis Kœnigii*, Link Enum. Hort. Berol. ii, 294 ; Steud. Syn. Gram. 266.—*Eragrostis interrupta*, Beauv. var. *Kœnigii*, Stapf in Hook. f. F.B.I. vii, 316 ; Cke. ii, 1024 ; Haines Bot. Bihar & Orissa (1924), 957.—*E. hapalantha*, Trin. in Mem. Acad. Petersb. ser. vi, i (1839), 409 (*partim*).—*E. minutiflora*, Presl. Rel. Haenk. i, 274 (*excl. syn.*) ; Lisboa in Journ. Bomb. Nat. Hist. Soc. vii. (1893), 386.—*E. mossulensis*, Steud. Syn. Gram. 264.—*E. nutans*, Nees in Wight Cat. no. 1776 ; Steud. Nom. ed. ii, i, 563 ; Duthie Grass. N. W. Ind. 38, Fodd. Grass. N. Ind. 63, t, 76 ; Aitchis, Cat. Panjab Pl. 169 ; Lisboa l. c. 381 ; Boiss. Fl. Or. v, 583.—*E. Rothii*, Steud. Syn. Gram. 267.—*E. stricta*, Steud. l.c. 264.—*E. verticillata*, Nees in Wight Cat. no. 1784.—*Poa nutans*, Koen. ex Roth Nov. Sp. 64; Roxb. Fl. Ind. i, 335 (*non* Retz.).—*Poa diarrhena*, Schult. Mant. 616.—*Eragrostis diarrhena*, Steud. Syn. Gram. 266.—*E. interrupta*, var. *diarrhena* Stapf l. c.—*Poa diandra*, Roxb. Fl. Ind. i, 336 (*non* Br.).—*Eragrostis diandra*, Aitchis. Cat. Panjab Pl. 169 (*non* Steud.) ; Duthie Grass. N.W. Ind. 37.—*Diplachne elongata*, Hochst. ex Steud. Syn. Gram. 268.–*Eragrostis diplachnoides*, Steud. l. c.–*Eragrostis interrupta*. var. *diplachnoides*, Stapf l. c.–*E. caudata*, Nees ex Steud. l. c. 264 ; Duthie Grass. N. W. Ind. 37.—*E. japonica*, Trin. in Mem. Acad. Petersb. ser. vi, i. (1831), 405.–*E. tenella* B. Roem. & Schult. Syst. ii, 356.—*E. tenella*, Benth. Fl. Hongk. 431, Fl. Austral. viii, 643 (*non* Beauv.) ; Duthie Fodd. Grass. N. Ind. 65, t. 78.—*E. tenellula*, Steud. Syn. Gram. 279.—*E. tenuissima*, Schrad. ex Nees Fl. Afr. Austr. 409, 410.—*E. interrupta*, var. *tenuissima*, Stapf l.c. ; Sedgwick and Saxton in Rec. Bot. Surv. Ind. vi, 219 ; Haines Bot. Bihar & Orissa (1924) 958.—*Poa Japonica*, Thumb. Fl. Jap. 31.—*P. tenella*, R. Br. Prodr. 181 (*non* Beauv.) ; Roxb. Fl. Ind, i, 337.—*P. tenellulla*, Kunth Enum. Pl. i, 338.

We have examined a great number of specimens from all parts of the Presidency. Most of them cannot be classed under any of the 4 varieties mentioned by Stapf. If we wanted to classify them we would have to greatly multiply the number of varieties which could not be satisfactory neither from a theoretical nor practical point of view. Cooke puts the Bombay material under *E. interrupta*, var. *Kœnigii*, Stapf. But then he has seen only one specimen from Surat. We have dropped all the varieties as can be seen from the above synonymy. The following description comprises them all.

Description : A very variable slender grass from 5-90 cm., annual or perennial. Stems smooth and polished, tufted, geniculate and ascending from the base, branched or not, nodes glabrous. Leaves slender, up to about 25 cm. long, narrow, flat, glabrous ; sheaths glabrous, close ; ligule a fimbriate membrane. Panicle exceedingly variable, up to 60 cm. long, either contracted with appressed branches or interrupted with many tiers of rather short spreading subwhorled branches (either long narrow with short dense suberect or erecto-patent pseudo-whorls or long effuse or contracted with solitary or 2-3-nate branches, simple or if branched the whorl rarely overtopped by 1 or 2 branches, ultimate branches not divaricate or long loose narrow, usually stiff, branches pseudo-whorled, spreading, ramified from the base, branchlets and pedicels divaricate- or long linear-oblong, branches up to 5 cm. long, hardly whorled, simple at the base, etc.). Spikelets usually very minute, from 1-6 mm. long, ovate to linear, few- to many-flowered. Flowering glumes obtuse, nerves slender, green or pale brown, rarely coloured, keels of pale scaberulous or smooth. Stamens 2. Grain obovoid.

Locality : Sind : Pad-Idan (Sabnis B513 !) ; Mirpurkhas, fallow fields (Sabnis B1175 !) ; Jamesabad (Sabnis B1164 !) ; Ganja Hill, near Hyderabad (Sabnis B996 !) ; Bhagar, Indus River (Blatter & McCann D650 !).—*Gujarat :* In water holes (Dalzell & Gibson) ; Dangs, 800 ft., rainfall 100 inches (Sedgwick & Bell 5392 !) ; Surat (Gammie 16436 !, Woodrow, Cooke) ; Kabirwad, Broach Dist. (Chibber !) ; Nadiad (Chibber !) ; road to Lasandra (Chibber !).—*Khandesh :* Tapti, Bhusawal, N. E. (Blatter & Hallberg 4437 !) ; Bor, Tapti Isl., sand and mud (Blatter & Hallberg 5475 !) ; Nim, Tapti, left bank (Blatter & Hallberg 5221 !) ; Amalner, Bori River (Blatter & Hallberg 4433 !); Muravat, Tapti bank (Blatter & Hallberg 5151 !, 5205 !) ; Bor (Blatter & Hallberg 5488 !) ; Chanseli Hill, northern slope (McCann 9986 !) ; Umalla, Tapti bank (Blatter & Hallberg 5214 !) ; Toramnal (McCann 9976 !, 9995 !).—*Konkan :* Tisgaon, near Kalyan (Garade !) ; Borivli to Kenery Caves (McCann 9989 !) ; Vihar Lake (McCann 9996 !); Pen (McCann 8556 !) ; Kase Dohan, Thana Dist. (Ryan 1920 !) ; Ghatkoper, Horse-shoe Valley (McCann 9994 !) ; Parel (McCann 5417 !) ; Sion (McCann 5246 !) ; Bassein (Lisboa) ; Thana (Lisboa) ; Alibag, rocky river bed (Ezekiel !).—*Deccan :* Bhowdan, near Poona (Woodrow) ; Bahuli, 14 miles N.W. of Poona (Woodrow) ; Ganeshkhind Botanic Gardens (Gammie !) ; Trimbak (Chibber !) ; Dhond, along river (Bhide 1349 !) ; Barsi River (Gammie 15766 !) ; Khandala, very common in fields (McCann 9998 !) ; Khandala to Karjat (Blatter & Hallberg 5322 !); Igatpuri (Blatter & Hallberg 5193 !) ; Bairawadi, Purandhar (McCann 5056 !) ; Tangawadi, Igatpuri (Blatter & Hallberg 3834 !) ; Lohagad (McCann 9987 !) ; Vaslang, Sholapur (D'Almeida 9980 !).—*S. M. Country :* Margin of tanks, Yelvigi, 1,800 ft., rainfall 28 inches (Sedgwick & Bell 3612 !) ; Dharwar, 2,400 ft., rainfall 34 inches (Sedgwick & Bell 4975 !) ; Dastikop, 2 500 ft., rainfall 35 inches (Sedgwick 2135 !).—*Kanara :* Halyal, 1,800 ft. (Talbot 2100 !) ; Kincholi (Talbot 944 !) ; Castle Rock, on banks of a tank (McCann 9993 !).

Distribution : India, Ceylon, tropical Asia and Africa.

7. **Eragrostis unioloides,** Nees ex Steud. Syn. Gram. 264 ; Trim. Cat. Ceyl. Pl. 109; Duthie Grass. N.W. Ind. 38; Fodd. Grass. N. Ind. 65; Aitchis. Cat. Panj. Pl. 170 ; Lisboa in Journ. Bomb. Nat. Hist. Soc. viii (1893), 363 ; Griseb. in Goett. Nachr. (1868), 76.—*Poa unioloides*, Retz. Obs. v, 19 ; Roxb. Fl. Ind. i, 330 ; Kunth Enum. Pl. i, 335 ; Grah. Cat. Bomb. Pl. 236.—*P. multiflora*, Roxb. Fl. Ind. i, 338.—*P. polymorpha*, R. Br. Prodr. 180.—*P. rubens*, Lamk. Illustr. i, 184, t. 45, f. 2 ; Kunth l.c. 335.—*Eragrostis amabilis*, Wight & Arn. ex Nees in Hook. & Arn. Bot. Beech. Voy. 251 (*non* Linn.); Nees in Act. Acad. Nat. Cur. xix, Suppl. i (1843), 205; Stapf in Hook. f. F.B.I. vii, 317; Cke. ii, 1025; Haines Bot. Bihar & Orissa (1922), 958.—*E. polymorpha*, Trin. ex Steud. Nom. ed. ii, i, 364, 562.—*E. rubens*, Hochst. ex Miq. Anal. Bot. ii, 26 ; Steud. Syn. Gram. 265.—*Briza rubra*, Lamk. Illustr. i, 187 ; Kunth l.c. 371.—*Uniola indica*, Spreng. Syst. i, 349 ; Dalz. & Gibs. Bomb. Fl. 298.—*Megastachya polymorpha*, Beauv. Agrost. 74.

Mr. Hubbard of Kew has helped us with regard to the synonymy of this species. He says in a letter : ' The combination *E. amabilis*, Wight & Arn. is based on *Poa amabilis*, Linn. but the majority of the references, the description and the specimens refer to a different plant which has for a long time been known under this name. It cannot, however, be called *E. amabilis*, Wight & Arn. and the next name for it is *Eragrostis unioloides*, Nees (*Poa unioloides*, Retz.). The fact that the name *E. amabilis* has been applied to a different species might be used as additional justification for rejecting it.'

Description : Cke. ii, 1025.

Locality : Sind : Mirpur Sakro (Blatter & McCann D651 !).—*Konkan :* Penn (Bhide !, McCann !) ; very common in the Bombay and Salsette Islands

(McCann !) ; Alibag (Ezekiel !) ; Uran (Hallberg & McCann 5130 !) ; Parel, Bombay Island (Woodrow) ; Bassein (Woodrow).—*Deccan :* Igatpuri (Blatter & Hallberg 5192 !, McCann !) ; Bairawadi, Purandhar (McCann 8739 !) ; Lohagad, way up (McCann 9504 !) ; Khandala, very common (Blatter 4375 !, 5440 !, McCann !) ; Lonavla (Woodrow 165) ; Poona (Woodrow) ; Katraj Ghat (Bhide !) ; Panchgani (Blatter 5387 !, Blatter & Hallberg B1243 !) ; Mahableshwar (Talbot 4511 !).—*S. M. Country :* Marshes N. of Belgaum (Ritchie 846) ; Dharwar (Sedgwick 2114 !).—*Kanara :* Karwar, sandy fields by the sea (Sedgwick & Bell 5086 !) ; Castle Rock (Gammie 15723 !) ; Dudsagar Falls (McCann 9985 !).

Distribution : India, Ceylon, tropical Asia.

8. **Eragrostis gangetica,** Steud. Syn. Gram. (1855), 266 ; Trim. Fl. Ceyl. v, 293 ; Stapf in Dyer Fl. Cap. vii (1900), 617 ; Prain Beng. Pl. 1221 ; Cke. ii, 1025 ; Haines Bot. Bihar & Orissa (1924), 958.—*E. elegantula,* Stapf in Hook. f. F.B.I. vii (1896), 318 (*non* Nees).

Description : Cke. ii, 1025.

' Very similar to *E. stenophylla* in the character of the panicle and the slatey-blue spikelets, but the longer striolate grain is correlated in all the specimens with the longer usually more acuminate glumes and slightly stouter pedicels than occur in *stenophylla.*' Haines.

Locality : Konkan : Vihar Lake (McCann 5096 !) ; Campoli (McCann 9409 !).—*Deccan :* Igatpuri (Blatter & Hallberg 5198 !) ; Khandala (McCann A10 !) ; Khandala to Karjat (Blatter & Hallberg A3 !) ; Poona, Canal (Ezekiel !) ; Borkas, Mawal, Poona Dist. (Woodrow) ; Panchgani (Blatter & Hallberg B1218 !, B1276 !) ; Lingmala, Mahableshwar, 4,000 ft., rainfall 200 inches (Sedgwick & Bell 4654 !).—*S. M. Country :* Hirdridihal, on the margin of a tank, 2,000 ft., rainfall 30 inches (Sedgwick 3801 !) ; Havasbhari, edge of a tank, 2,000 ft., rainfall 35 inches (Sedgwick 2110 !) ; Tadas, tank, 2,500 ft., rainfall 35 inches (Sedgwick 1910 !) ; Dharwar, rice field (Talbot 2637 !) ; Londa (Bhide !).—*Kanara :* Karwar (Talbot !) ; Halyal (Talbot 2381 !) ; Tinai Ghat (Gammie 15808).

Distribution : India, Ceylon.

9. **Eragrostis stenophylla,** Hochst. ex Miq. Anal. Bot. Ind. ii (1851), 27 ; Lisboa in Journ. Bomb. Nat. Hist Soc. vii (1893), 385 ; Stapf in Hook. f. F.B.I. vii, 318 (*excl. aliq. syn.*) ; Trim. Fl. Ceyl. v, 294 ; Prain Beng. Pl. 1221 ; Cke. ii, 1026 ; Haines Bot. Bihar & Orissa (1924), 959.—*E. Brownei,* Nees in Wight Cat. (1833) No. 1780 (*partim*) ; *E. elegantula,* Nees l.c. 1781, α, β (*non* Steud.) ; Duthie Grass N.W. Ind. 37, Fodd. Grass. N. Ind. 63, t. 74.

Description : Cke. ii, 1026.

Locality : Khandesh : Tapti Island, near Bor, on sand and mud (Blatter & Hallberg 5470 !) ; Umalla, Tapti, on sand (Blatter & Hallberg 5180 !).—*Konkan :* Uran (Hallberg & McCann 5134 !) ; Malwan (Woodrow).—*Deccan :* Khandala (McCann 5319 !) ; Igatpuri (Blatter & Hallberg 5142 !) ; Pashan, near Poona (Gammie !) ; Purandhar (McCann 5601 !) ; Panchgani (Blatter & Hallberg B1316 !) ; Barkas, Mawal, Poona Dist. (Woodrow).—*S. M. Country :* Hirbudihal, on the margin of a tank (Sedgwick 2081 !).—*Kanara :* Halyal (Talbot 2165 !) ; Kulgi (Talbot !).

Distribution : India, Ceylon, tropical Asia and Africa.

10. **Eragrostis Eragrostis,** Blatter & McCann, *nov. comb.* (*non* Karst. *quae est E. minor,* Host.).—*Briza Eragrostis,* Linn. Sp. Pl. 70 ; Schreb. Beschr. Gräs. ii, 74.—*Poa Eragrostis,* Cav. Ic. i (1791), 63, t. 92 ; Sibth. Fl. Graec. t. 73.—*Megastachya Eragrostis,* Beauv. Agrost. (1812), 74.—*Briza oblonga,* Moench Meth. (1802), 185.—*Eragrostis maior,* Host. Gram. Austr. iv (1809), 14, t. 24 ; Hook. f. F.B.I. vii, 320 ; Cke. ii, 1026 ; Haines Bot. Bihar & Orissa (1924), 959.—*E. flexuosa,* Steud. Syn. Gram. 266 ; Duthie Grass. N.W. India 37.—*E. megastachya,* Link Enum. Hort. Berol. i (1820), 187 ; Kunth Enum. Pl. i, 333 ; Reichb. Ic. Fl. Germ. t. 91 ; Aitchis. Cat. Panjab Pl. 169 ; Duthie Grass. N.W. Ind. 38, Fodd. Grass. N. Ind. 63, t. 75 ; Lisboa in Journ. Bomb. Nat. Hist. Soc. vii (1893), 382 ; Boiss. Fl. Or. v, 580.—*E. multiflora,* Aschers. ex Boiss. l.c.—*Poa multiflora,* Forsk. Fl. Aeg.-Arab. lxi, no. 58, civ, no. 69, p. 21.—*Eragrostis pœoides,* Trin. in Mem. Acad. Petersb. ser. vi, i (1831), 404.—*E. vulgaris* var. *megastachya,* Coss. *et* Dur. Fl. Alger. 148.—*Poa*

ciliancnsis, All. Fl. Pedem. ii, 246, t. 91, f. 2.—*P. flexuosa*, Roxb. Fl. Ind. i, 339.—*P. Roxburghiana*, Schult. Mant. ii, 315.—*P. tortuosa*, Spreng, Syst. Veg. i (1825), 345.

Description : Cke. ii, 1026.

Locality : Sind : Sanghar (Sabnis B897 !, B753 !) ; Mirpurkhas, on bank of dry watercourse (Sabnis B1024).—*Gujarat :* Kabirwad, Broach (Gammie !) ; Morvi, Kathiawar (Woodrow).—*Khandesh:* Chauseli, N. slope (McCann A14 !) ; Nim, Tapti bank (Blatter & Hallberg 5109 !); Umalla, Tapti sand (Blatter & Hallberg 5177 !) ; Bor, Tapti sand (Blatter & Hallberg 5187 !).—*Konkan :* Mahalaxmi, Clerk Road, along brackish water (Sabnis A13 !).—*Deccan :* Kannala, Sholapur Dist. (Mamlatdar of Kannala !) ; Purandhar (McCann 5039 !); Khandala, road (Blatter 5445 !); Kirkee (Gammie 896 !); Poona (Jacquemont 349, Woodrow), Agricultural College Farm (Ezekiel !).—*S.M. Country :* Dharwar, 2,400 ft., rainfall 34 inches (Sedgwick 2834 !) ; Badami (Woodrow).—*Kanara :* Halyal (Talbot 2159 !).

Distribution : India, Ceylon, westwards to the Mediterranean, tropical and subtropical Asia.

11. **Eragrostis minor,** Host Gram. Austr. iv (1809), 15 (*in nota*), *et* in Fl. Austr. i (1827), 135 ; Stapf in Hook. f. F. B. I. vii, 321 ; Cke. ii, 1027 ; Haines Bot. Bihar & Orissa (1924), 960.—*E. poœformis*, Link Hort. Berol. i, 188 ; Reichb. Ic. Fl. Germ. t. 91.—*E. poœoides*, Beauv. Agrost. 76 ; Duthie Grass. N. W.Ind. 38, Fodd. Grass. N. Ind. 65 ; Aitchis. Cat. Panjab Pl. 170 ; Lisboa in Journ. Bomb. Nat. Hist. Soc. vii (1893), 387 ; Boiss. Fl. Or. v, 580.—*E. poœoides* β, Trin. in Mem. Acad. Petersb. ser. vi, i (1831), 404.—*Poa Eragrostis*, Linn. Sp. Pl. 68 (*partim* !) ; Kunth Enum. Pl. i, 332 ; Schreb. Beschr. Graes. ii, t. 38 ; Host Gram. Austr. ii, 50, t. 69.—*Briza Eragrostis*, Vill. Fl. Delph. ii, 50 (*non* Linn.).

Description : Cke. ii, 1027.— Stapf l.c. considers the glands on the leaf-margins as 'a very constant character'. It would be better to say that the margins are usually glandular.

Locality : Sind : Jamesabad, in fields (Sabnis B1111 !) ; Pad-Idan (Sabnis B510 !) ; Larkana (Sabnis B476 !); Sanghar (Sabnis B751 !, B752 !).—*Gujarat :* Godra (Woodrow) ; Panch Mahals (Woodrow—*Khandesh :* Umalla, Tapti sand (Blatter & Hallberg 5180 !) ; Tapti Island near Bor, on sand and mud (Blatter & Hallberg 4449 !, 5470 !); Manmad, Redmond's garden (Blatter A12 !) ; Tapti Bhusawal, N. E. (Hallberg 5112 !).—*Konkan :* Parel (McCann 5376 !); Bombay (Lambert).—*Deccan :* Tangawadi, Igatpuri (Blatter & Hallberg 5835 !) ; Purandhar (McCann 5601!); Bhimthadi, Poona Dist.(Mamlatdar of Bhimthadi!); Man, Satara Dist. (Mamlatdar of Man !) ; Poona (Jacquement 350), Chattarshinji Hill (Ezekiel !) ; Nasik (Lisboa).—*S. M. Country :* Dharwar, 2,400 ft., rainfall 34 inches (Sedgwick & Bell 4487 !); Gokak hills (Shevade !).

Distribution : India, Afghanistan, tropical Africa.

12. **Eragrostis tremula,** Hochst. in Schimp. Pl. Abyss. no. 6, in Flora (1842) I, Beibl. 134 ; Duthie Fodd. Grass. N. Ind. 65, t. 79 ; Lisboa in Journ. Bomb. Nat Hist. Soc. vii (1893), 382 ; Boiss. Fl., Or. v, 581 ; Prain Beng. Pl. 1221 ; Stapf in Hook. f. F. B. I. vii, 320 ; Cke. ii, 1027 ; Haines Bot. Bihar & Orissa (1924), 960.—*Poa tremula*, Lamk. Ill. i, 185.—*Eragrostis multiflora*, Trin. in Mem. Acad. Petersb. ser. vi, i (1841), 401 ; Dalz. & Gibs. Bomb. Fl. 298 ; Duthie Grass. N. W. Ind. 38 ; Aitchis. Cat. Panjab. Pl. 169.—*Poa multiflora*, Roxb. Fl. Ind. i, 338 (*non* Forsk.).—*Eragrostis rhachitricha*, Hochst. ex Miq, Anal. Bot. Ind. pt. ii (1851), 25 ; Watt Dict. Econ. Prod. iii, 256.

Description : Cke. ii, 1027.

Locality : Cutch : Sumrasar (Blatter !).—*Gujarat :* Sevalia (Chibber !) ; Perim Island, Gulf of Cambay (Blatter !); Gogo, Kathiawar (Dalzell & Gibson, Woodrow).—*Deccan :* Lonavia (Lisboa).—*S. M. Country :* Londa, on a rock in the river bed (Bhide !); Gadag (Bhide !).

Distribution : India, Afghanistan, tropical Africa.

13. **Eragrostis tenuifolia,** Hochst. in Flora 24 (1841) i, Intelligenz. 20 (*nomen nudum*) ; Stapf in Hook. f. F. B. I. vii, 322 ; Cke. ii, 1027 ; Prain Beng. Pl. 1221.—*Poa tenuifolia*, A. Rich. Tent. Fl. Abyss. ii, 425.—*E. collocarpa*, K. Schum. in Engler's Pflanzenw. Deutsch—Ost Afr. C. 114.—*E. parviglumis*, Hochst. ex Steud. Syn. Gram. 268.

Description : Cke. ii, 1027.

Locality : Deccan : Panchgani (Blatter & Hallberg B1313 !, B1317 !).—*S. M. Country :* Belgaum (Ritchie).—*Kanara :* Dandeli, 1,800 ft., rainfall 100 inches (Sedgwick & Bell 4206 !).

Distribution : W. Peninsula, tropical Africa.

14. **Eragrostis papposa,** Steud. Nom. ed. ii, i, 564 ; Stapf in Hook. f. F.B.I. vii, 322.—*Poa papposa,* Desf. in Roem. & Schult. Syst. ii, 585.—*P. nigra,* Clem. ex Willk. & Lange Prodr. Fl. Hisp. i, 83.—*Eragrostis atro-virens,* Lange in Koebj. Vedinsk. Meddel. (1860) (*non* Desf.).—*E. rigidifolia,* Hochst. Herb. Mem. Div. Forsk. (*nomen*).—*E. speirostachya,* Coss. *et* Dur. ex Lange l.c.—*E. vulgaris,* var. *speirostachya,* Coss. *et* Dur. Fl. Alger. 148.—*E. verticillata,* Coss. ex Lange l.c. (*non* Cav.).

Description : An elegant perennial. Stems 30–50 cm. high, very slender, simple. Leaves short, strict, very narrow, convolute ; mouth of sheath bearded with long silky hairs. Panicle 10–20 cm. long, ovoid, very delicate, lax, open, sparingly branched ; rhachis filiform, glabrous ; branches solitary, alternate, rarely binate, spreading, almost capillary, naked below, loosely branched beyond the middle with capillary, spreading, stiff branchlets ; pedicels long, capillary. Spikelets 4–8 mm. long, linear, 7-23-flowered, very pale yellow or dark or pale olive-grey ; rhachilla tough. Involucral glumes subequal or lower shorter, hyaline ; lower involucral glume 1 mm. long, usually less, nerveless, upper slightly longer, faintly 1-nerved. Flowering glumes broadly ovate, margins above hyaline, about 1·5 mm. long ; pale rather shorter, obtuse, denticulate, persistent, keels scabrid. Stamens 3, anthers ¼ mm. long. Grain obovoid, about ½ mm. long, dorsally grooved.

Locality : Sind (ex Agharkar).

Distribution : Punjab; Trans-Indus districts, westward to Arabia, N. Africa, Spain.

15. **Eragrostis pilosa,** Beauv. Agrost. (1812), 71 ; Reichb. Ic. Fl. Germ. t. 91 ; Duthie Grass. N. W. Ind. 38, Fodd. Grass. N. Ind. 64 ; Aitchis. Cat. Panjab Pl. 170 ; Lisboa in Journ. Bomb. Nat. Hist. Soc. vii (1893), 381 ; Boiss. Fl. Or. v, 581 ; Stapf in Hook. f. F.B.I. vii, 323 ; Cke. ii, 1028 ; Haines Bot. Bihar & Orissa (1924), 960.—*Poa pilosa,* Linn. Sp. Pl. 68 ; Host Gram. Austr. ii, 168, t. 68.—*Eragrostis indica,* Steud. Syn. Gram. 264.—*E. parviflora,* Trin. in Mem. Acad. Petersb. ser. vi, i (1831), 411.—*E. pellucida,* Steud. l.c. 279.—*E. punctata,* Link ex Steud. Nom. ed. ii, i, 561, Syn. Gram. 264.—*E. verticillata,* Roem. & Schult. Syst. ii, 575 ; Reichb. Ic. Fl. Germ. t. 9 ; Aitchis. Cat. Panjab Pl. 170.—*Poa indica,* Koen. ex Rottl. in Ges. Naturf. Fr. Berl. Neue Schrift iv (1803), 194.—*P. parviflora et pellucida,* R. Br. Prodr. 180.—*P. punctata,* Linn. f. Suppl. 109 ; Kunth Enum. Pl. i, 330 ; Roxb. Fl. Ind. i, 338.—*P. verticillata,* Cav. Ic. i, 63, t. 93 ; Kunth Enum. Pl. 329.

Description : Cke. ii, 1028.

Locality : Sind : Sanghar (Sabnis B902 !).—*Konkan :* Byculla, common in Bombay Isl. (McCann A8 !) ; Karjat (Halberg 3602 !) ; Kalyan (Garade !).—*Deccan :* Lina Hill, Nasik Dist. (Blatter & Hallberg 9975 !) ; Khandala (McCann A7 !) ; Nasik (Lisboa) ; Deolali (Blatter & Hallberg 4559 !) ; Igatpuri (McCann 4590 !) ; Gangapur (Blatter & Hallberg 4578 !) ; Waghoti, Mawal, Poona Dist. (Woodrow) ; Poona (Cooke), Chattarshinji (Ezekiel !) ; Ganeshkhind Botanic Gardens (Supt. of the Gardens !) ; Bairawadi, Purandhar (McCann 5068 !).—*S. M. Country :* Dharwar (Sedgwick 2672 !, Woodrow).

Distribution : Most warm countries.

16. **Eragrostis bifaria,** Wight ex Steud. Nom. ed. 2, i (1840), 562, Syn. Gram. 264, Suppl. 282 ; Lisboa in Journ. Bomb. Nat. Hist. Soc. vii (1893), 387 ; Stapf in Hook. f. F.B.I. vii, 325 ; Cke. ii, 1029.—*Poa bifaria,* Vahl Symb. ii. 19 ; Roxb Fl. Ind. i, 331 ; Kunth Rev. Gram. i, 334, t. 80, Enum. Pl. i, 327, Suppl. 282.

Description : Cke. ii, 1029.

Locality : Konkan : Bassein (Chibber !) ; Matheran (Gammie 16649 !) ; Parsik, hill (Ryan 1147 !) ; Wada range, Thana Dist. (Ryan 687 !).—*Deccan :* Sinhagad, forests (Bhide !) ; Kirkee (Garade 479 !) ; Chattarshinji Hill, Poona (Ezekiel !) ; Khandala (Woodrow).—*S. M. Country :* between Yelvigi and Savanur, dry hill side, 1,800 ft. (Sedgwick 2019 !) ; Hubli, dry hill sides, 2,00 ft., rainfall 28 inches (Sedgwick & Bell 4915 !) ; Badami (Talbot 2927 !) ; Haveri (Talbot 2179 !) ; Belgaum (Ritchie).

Distribution : W. Peninsula, tropical Africa.

17. **Eragrostis brachyphylla,** Stapf in Hook. f. F.B.I. vii, 327 ; Haines Bot. Bihar & Orissa (1924), 961.

Description : Perennial. Stem erect, slender, 25-45 cm. high, from a tuft of old fibrous leaf-sheaths. Leaves nearly all radical, 5-10 cm. long, 2·5 mm. broad, coriaceous, linear, flat or conduplicate, obtuse or subacute, glabrous above. Spikes 7-20 cm. long, slender. Spikelets 6-18 mm. long, close-set, linear or linear-oblong, secund, 2-seriate, slightly compressed, olive-green, about 20-flowered, lenticular in section. Glumes closely imbricate, involucral ones subequal, up to 2 mm. long, lower one acute, acutely keeled, upper obtuse, dorsally rounded. Flowering glumes up to 2·5 mm. long, rather turgidly broadly ovate (when unfolded) with rounded tip or obtuse, lateral nerves very weak, midrib microscopically scabrid. Pale as large, somewhat obovate, concave towards rhachilla, keels scabrid, narrow. Grain very small, shortly ellipsoid, obscurely trigonous, epicarp coarsely reticulate.

Locality : Gujarat : Sevalia (Chibber !).—*S. M. Country :* Badami Fort (Bhide !).

Distribution : Bihar, Central Provinces, W. Peninsula.

82. HALOPYRUM, Stapf; Cke. ii, 1029.

Species 1.—Coasts of India and Ceylon, Arabia, tropical Africa.

1. **Halopyrum mucronatum,** Stapf in Hook. Ic. Pl. t. 2448 ; Hook. f. in F.B.I. vii, 328 ; Trim. Fl. Ceyl. v, 299 ; Cke. ii, 1029.—*Brizopyrum mucronatum,* Nees in Wall. Cat. no. 8898.—*Desmazeria unioloides,* Defl. Voy. Yemen 220.—*Eragrostis mucronata,* Trim. Cat. Ceyl. Pl. 109 (*non* Roem. & Schult.).—*Triticum repens,* Thw. Enum. Pl. Zeyl. 376.—*Aeluropus,* Aitchis. Cat. Panj. Pl. 169.—*Eragrostis sp. Sect. Sclerostachya,* Benth. in Gen. Pl. iii, 1187.

Description : Cke. ii, 1029.

Locality : Sind : Clifton, near Karachi (Sabnis B796 !) ; Manora Island, Karachi Harbour (Sabnis B832 !).—*Gujarat :* Porbandar (Bhide ! Bhiva).

83. DIPLACHNE, P. Beauv.; Cke. ii, 1030.

Species about 20.—Warm regions.—Only 1 species in the Presidency.

1. **Diplachne fusca,** Beauv. Agrost. (1812), 163 ; Boiss. Fl. Or. v, 561 ; Hook. f. F.B.I. vii, 329 ; Trim. Fl. Ceyl. v, 299 ; Cke. ii, 1030 ; Haines Bot. Bihar & Orissa (1924), 962.—*Festuca fusca,* Linn. Sp. Pl. 109 ; Del. Fl. d'Egypt. 24, t. xi, f. 1.—*Uralepis fusca,* Steud. Syn. Gram. 247.—*Diplachne indica,* Spreng. Syst. i, 351.—*Tridens indicus,* Nees in Wight Cat. No. 1794.—*Festuca indica,* Retz. Obs. iv, 21 ; Kunth Enum. 412.—*Eragrostis procera,* Steud. l.c. 266.—*Poa procera,* Roxb. Fl. Ind. i, 322.—*Urolepis Drummondii,* Steud. l.c.—*Triodia ambigua,* R. Br. Prodr. 183.—*Bromus polystachios,* Forsk. Fl. Aeg.—Arab. 23.

Description : Cke. ii, 1030.

Locality : Sind : Tatta, Kullan Kote Lake (Blatter & McCann D639 !).—*Konkan :* Parsik, side of railway line (McCann A24 !) ; Bassein (Bhide !) ; Sion (McCann 5238 !) ; Alibag, rice fields near salt marshes (Ezekiel !) ; Lower Parel (Blatter 4283 !) ; Antop Hill (McCann 3614 !) ; Mahim to Matunga (McCann 5139 !) ; Matunga, near Bombay, in rice fields (Woodrow 10).—*Kanara :* Near Karwar, maritime marsh (Sedgwick & Bell 5095 !).

Distribution : Upper Gangetic Plain, Bengal, Orissa, W. Peninsula, Ceylon, Egypt, tropical Asia, Africa, and Australia.

84. LEPTOCHLOA, P. Beauv.

Annual grasses. Leaves flat or involute. Spikelets very minute, compressed, 1-many-flowered, sessile or shortly pedicelled, alternate and unilaterally 2-seriate on the very slender spiciform branches of a lax panicle, sessile or minutely pedicelled, not jointed at the base ; rhachilla jointed at the base and beneath each glume, produced between each glume and often beyond the terminal. Glumes usually 2 (sometimes 1-)-many-flowering, membranous, Involucral glumes subequal or unequal, oblong, lanceolate, or almost linear-lanceolate, 1-nerved ; lower and other flowering glumes ovate when unfolded, subacute or obtuse, 3-nerved, 1 nerve in the keel and usually 1 near each margin, nerves usually hairy ; pale shorter, 2-nerved. Lodicules 2, cuneate, Anthers 3, short. Styles free. Grain subglobose, oblong, obovoid or 3-gonous closely invested by the glume or pale.

Species probably 20, in the warmer regions.

This genus is not represented in Cooke's Flora.

Key :

1. Spikes 1–7·5, rarely 10 cm. long, Spikelets 2–3–flowered, under 2·5 mm. long ... 1. *L. filiformis.*
2. Spikes 5-10 cm. long. Spikeletes 4–6-flowered, 2·5 mm. long ... 2. *L. chinensis.*

1. **Leptochloa filiformis,** Roem. & Schult. Syst. ii, 580 ; Kunth Enum. Pl. i, 270, Suppl. 220 ; Steud. Syn. Gram. 209 ; Duthie Grass. N. W. Ind. 192 ; Aitchis. Cat. Panj. Pl. 167 ; Hook. f. F.B.I. vii, 298 ; Haines Bot. Bihar & Orissa (1924), 972.—*Eragrostis chinensis*, Duthie Fodd. Grass. N. Ind. 59, t. 71.—*Aira filiformis*, Roxb. Fl. Ind. i, 326.—*Poa malabarica*, Klein ex Steud. Nom. ed. ii, 303, 60.—*P. contrecta et panicea*, Retz. Obs. iii, 11.—*P. virgata*, Roth Nov. Sp. 66.

Description : A very slender grass, 30–70 cm. high. Stems tufted and geniculately ascending. Leaves flat, flaccid, 10–25 cm. long, finely acuminate, sometimes sparsely hairy on the nerves and on the sheaths ; ligule short, erose or setosely lacerate. Panicle 10–20 cm. long, contracted or diffuse. Spikes 1–7·5 or up to 10 or even 12·5 cm. long, exceedingly filiform with 2-nerved rhachis. Spikelets about 1 mm. long, 2–3-flowered, distant nearly their own length on the rhachis on very short pedicels. Involucral glumes linear-or oblong-lanceolate. Flowering glumes 2–3, broadly ovate, rather shorter than the upper involucral glume, with median nerve and sub-marginal nerves microscopically hairy ; pale rather shorter, reduplicate. Grain fusiform-oblong, pericarp adherent, but slightly produced each end.

Locality : Gujarat : Surat, near Athwa Farm (Bhide !) ; Ahmedabad in garden (Sedgwick !).—*Konkan :* Parel, Bombay Island (Talbot !) ; Victoria Gardens, Bombay Island (McCann 5351 !, 5568 !) ; Byculla, Bombay Island (McCann A40 !).

Distribution : Throughout India and Burma, Ceylon, tropical Asia, Africa and America.

2. **Leptochloa chinensis,** Nees in Syll. Ratisb. i (1824), 4, Agrost. Bras. 432 ; Benth. Fl. Hongk. 430, Fl. Austral, vii, 617 ; Duthie Grass. N. W. Ind. 35 (*excl. syn.*), Fodd. Grass. N. Ind, 59, t. 71 ; Lisboa in Journ. Bomb. Nat. Hist. Soc. vii (1893), 372 (*excl. syn. tenerrima*) ; Hook. f. F.B.I. vii. 299 ; Haines Bot. Bihar & Orissa (1924), 972.—*Poa chinensis*, Linn. Sp. Pl. 69 (*excl. syn.* Burm.) ; Roxb. Fl. Ind. i, 332.—*P. malabarica*, Retz. Obs. v, 19.—*P. asthenes*, Roem. & Schult. Syst. ii, 574.—*P. decipiens*, R. Br. Prodr. 181.

Description : Stem tall, stout, 60–120 cm. high, erect or geniculately ascending. Leaves 15–45 cm. long, flat or convolute, scaberulous ; sheaths loose ; ligule short, lacerate. Panicle 15-25 cm. long. Branches numerous, slender, simple, opposite or alternate, suberect or spreading, 5–10 cm. long. Spikelets 4–6-flowered, about 2·5 mm. long, alternate, short-pedicelled, distant or approximated, narrow. Involucral glumes somewhat unequal, lanceolate, acute or subulate. Flowering glumes broader, lower apiculate with pilose nerves ; nerves of pale pilose. Grain loose, obtusely trigonous, subrugose.

Locality : Gujarat : (ex Lisboa).—*Konkan :* Parel, Bombay Island (ex Lisboa.—*S. M. Country :* Kilgerry Tank (Talbot !).

Distribution : Throughout India and Burma, Ceylon, Malaya, China, Japan, Australia.

Note : Haines thinks that the two species are scarcely more than varieties. We can't say how far this view is correct as we have seen only a few specimens

(*To be continued*)

A GRASSHOPPER MIMIC (*ISOPSERA PEDUNCULATA*)

BY

MAJOR R. W. G. HINGSTON

(*With one plate*)

The large Black Ant, *Camponotus compressus*,[1] is a common insect on the Indian plains. It establishes its nest at the foot of a tree. A feature about it is the two castes, large soldiers and smaller workers. The soldiers as a rule guard the nest. The smaller workers ascend the foliage and search methodically for supplies. During the cold season the ant disappears, remaining hidden underground. In March and April it becomes active. The workers then commence rebuilding their galleries and gathering in supplies. But it is not until the rainy season that the commune develops into full life. Large gatherings then congregate round the gate of the formicary ; sexual forms establish new colonies ; dense armies are despatched into the trees. An endless stream of busy labourers continually enters and leaves the nest.

If we examine the bushes at this season we are likely to meet with a small grasshopper that very closely resembles these ants. We must search the places which the ants frequent, for the grasshopper has the habit of keeping in their company and haunting the places where they abound. Moreover, our scrutiny must be carefully made. It will not suffice just to inspect the leaves and glance along the multitude of moving spots. Each ant must be examined individually ; otherwise the mimic will never be seen. Often I have pointed one out to a friend, and he invariably took it to be an ant.

The mimic is the larva of a long-horned grasshopper belonging to the species *Isopsera pedunculata*, Br. W. In my garden at Fyzabad it appeared in abundance shortly after the break of the monsoon. The eggs of the grasshopper had lain dormant through the winter implanted between the layers of a leaf. With the first touch of moisture they awakened. Like the seeds of plants hidden in the soil they had burst into active life.

Let us look at the mimic carefully. (See Plate, Fig. 1.) It is about the size of a small worker ant, quarter of an inch in length. Like its model it is almost uniform black and of the same build and shape. There is no trace of wings nor vestige of wing-covers. Its back is completely bare like the naked surface of an ant. It has the slender ant-like pattern of legs, possesses the same humped type of thorax, the same globular-shaped abdomen like that of an ant swollen with food. Being a leaping insect, its hind legs are dilated, but the enlargement has been done without much injury to the resemblance, since the swelling of the thighs is very gradual, also the shanks are of slender dimensions, and the legs bent in such an ant-like attitude that they do not look like legs of a springing insect, at least in the natural haunts.

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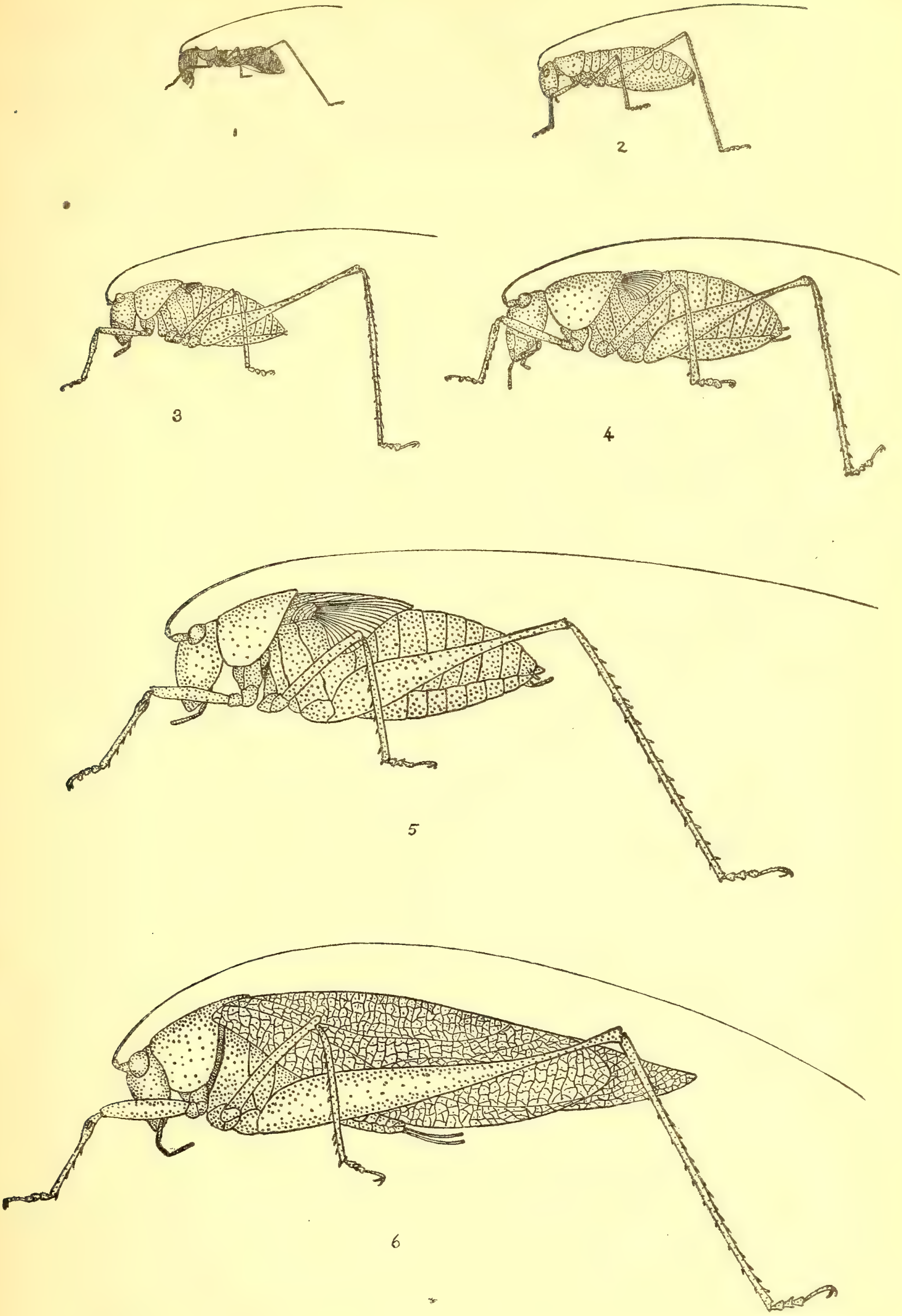
[1] The habits of this ant have been described in *A Naturalist in Hindustan*.

But there is another point about the mimic which shows how efficiently it has been modified in order to complete its resemblance to an ant. Grasshoppers are insects with broad waists : ants have their waists constricted to a thread. Such a contrast would destroy the harmony were it not rectified by a simple device. The grasshopper's colours are arranged to make it look as if it had a waist. This is seen only in the larger examples. It is like the device described by Brunner in *Myrmecophana fallax* from the Soudan. There is a yellow patch at the front of the abdomen. It is spread over half the under surface and up along either side. It forms an area of pale colour in exactly that part of the grasshopper's body which corresponds to the ant's waist. This pale area gives the impression of deficiency. It suggests a loss of substance, which gives the idea of a waist. Thus, where structure cannot be modified, the end is obtained by simulation and deceit.

The similarity between mimic and model is seen in their habits of life also. Structure and habit are interwoven to fulfil the same end. The grasshopper, for example, has quick movements and keeps its antennae in tremulous motion, both of which resemble the ants. It occupies the places frequented by its model, climbing up tree-trunks, wandering round nest-holes; but usually keeping to the green foliage in which these ants abound. Some ants retire to the nest at sunset, but *Camponotus compressus* remains out all night. And so do the mimics spend the night with the ants exploring the stems and leaves.

What can be the purpose of this similarity ? It can only be defensive. It helps the grasshopper to escape its foes. Black ants are well protected. They shoot out poison and have powerful jaws. They are very conspicuous, abound everywhere, yet very rarely are they taken by birds. As a consequence they have many mimics. There is a bug, a mantis, and two kinds of spiders which resemble them in the closest degree. In the case of the spiders the mimicry is aggressive. It enables them to capture the ants. With the grasshopper, however, the purpose is protective. These insects are purely vegetable feeders. They are quite incapable of capturing ants. Their enemies are probably the hunting-spiders which prowl about near the ant's nests. They will also be taken by insectivorous birds. I suspect that they have a hymenopterous parasite which searches for them amongst the ants. From these enemies they have no very special defences. Hence the resort to simulation. They escape through being mistaken for ants.

These mimics like the tenderest shoots. When suddenly alarmed, they first sit motionless, their long antennae stretched out, quivering and searching the air. Often they dodge underneath a leaf. But if this is not enough or if the danger presses, the mimic makes a sudden spring and disappears into the foliage beneath. Their capacity for leaping is not great, and they are quite incapable of flight. Hence the valuable instinct of plunging into the thickest part of the bush. Their bodies are remarkably fragile, especially the



Isopsera Pedunculata. Stages of Development.

long hind legs which break off at the slightest touch. When a little bigger they spit out a juice, probably an unpleasant fluid of some use as a defence.

It is only at this early period that the grasshopper resembles an ant. As well as I can tell from my attempts to rear it, its growth consists of seven stages. At the second stage the mimicry is closest. The resemblance diminishes with development : in the end completely disappears.

Let us follow the mimic's development. It has already had one moult by the time it reaches the mimicking stage. We have seen that it is black, its antennae paler ; there is a yellow spot on each hind shank. As it grows its colour changes. After the second moult (See Plate, Fig. 2) the black is less intense and patches of yellow begin to appear. A yellow line runs across the thorax : a yellow blotch comes on the base of the abdomen : the yellow on the shank becomes more distinct. There is little more than a suggestion of the ant-like resemblance of the previous stage. A third moult terminates the mimicry (See Plate, Fig. 3). The black is gone. The insect is leaf green. Not a trace of the ant remains. It has grown too large for mimicry to be effective. Also it is entering another sphere of life, one in which it will harmonize with leaves. There is still just a trace of the original black, a broken streak along each side, and some brownish markings on the abdomen and legs. Its previous ant-like activities have lessened. It is getting sluggish and inert. Also it is growing more individualistic. It wanders away from the gatherings of ants.

A fourth moult intensifies the green (See Plate, Fig. 4). The darkish streak on each side has disappeared. A few black spots on the middle of the back is all that remains of the ant-like dress. The grasshopper's shape is changing markedly. Its slender body, so essential before, is now becoming massive and stout. The imaginary waist has disappeared. The abdomen, which before was oval, is now laterally compressed. Some locustid features are becoming conspicuous, especially the hind legs which are getting dilated, the stumps of wings which are shooting from the back, the curved ovipositor which, in the female, is projecting from the hind end. The insect is now clearly a young grasshopper. It could not be mistaken for anything else.

A fifth moult brings further change (See Plate, Fig. 5). The colour distribution has not much altered. Except for the black line on the back and the yellow streak behind each eye the grasshopper is uniform green. Its body is now deep and markedly compressed. The female possesses a powerful ovipositor. A large part of the abdomen is hidden beneath the stumps of half-developed wings.

A sixth moult gives us the mature insect (See Plate, Fig. 6). Of all the transformations this is the most striking. We have now a full-grown grasshopper furnished with gauzy wings. I have sometimes witnessed this final metamorphosis. A rent first occurs across the insect's back. The edges of the skin then separate widely, and the grasshopper comes out through the breach. At first it is pale with a yellow tinge. Exposure to the air is necessary for the production of the leaf-green tint. Also it is weak from the sudden transformation, its body being soft and compressible, and its legs as flexible as if they were threads. Its wings too are delicately fragile. It is they which have undergone the most elaborate transformation, since their gauzy sheets and elongated covers have come out from mere stumpy sacs. As a consequence they are very crumpled, also they are limp and droop about the body with their points trailing helplessly behind. They need the stiffening that will follow on exposure before being fit for flight. Otherwise the insect is complete, and dressed in its final garb. It remains near its cast-off skin while the strengthening of its organs rapidly takes place. The legs become hard, the wings stiffen, the antennæ, which at first were pale, assume a dark tint. It has become a virile locust, anatomically and physiologically complete.

Its body length is about one inch. With the hind legs pulled back and antennæ drawn forward it measures three inches or more. Thus the little mimic has become immense. Who would think that it once resembled an ant? It is not without some trace of elegance, chiefly because of its rich green dress. The female is particularly striking because of the powerful conspicuous sword that curves up from her posterior end. But the special point of interest lies in the wings. They are long and oval, green in colour, and permeated with a delicate system of veins. In fact they resemble very closely a narrow oval leaf. It is this which now protects the insect. What in early life it gained by mimicry, it now secures by resembling a leaf.

This shedding of integument is a serious business. It must be responsible for much mortality at a precarious period of life. Apart from the dangers connected with shedding, the developmental period has other perils. The insect's colours are in a transitory state. They have ceased to resemble the ant and have not yet come to resemble the leaf. Hence the insect is an easier prey. To this are added the moulting dangers. For the shedding is not without complications. The legs and antennæ cannot always be withdrawn without sometimes getting torn. Also, when moulting the grasshopper is helpless, its body being tangled in the separating skin. Moreover, the act of shedding enfeebles it, and for a time it is an easy prey. Also, when moulting, they appear less hardy. When kept in a cage, the developing ones die more easily than do the adults. The last moult is particularly dangerous. Often the insects perish in the act. One which I found, had died in this way. Its body was still entangled in the skin: the wings had got properly out of their sheaths: but the antennæ were broken at their bases and the hind legs were only partially out. I found another which had failed to harden after moulting. Its wings were all crumpled: they had never stiffened, and the creature was permanently incapable of flight.

As a rule, however, the shedding is perfect. Every particle of integument is removed. Indeed the perfection of the act surprises us. That the hair-like antennæ should come out entire shows how perfect must be the separation all round the long fragile thread. The slightest adhesion would stop withdrawal or would cause inversion of the sheath. But accidents of this kind seldom occur. As a rule there is neither crumpling nor inverting : each antennæ comes from its tube like a sword drawn out of its case.

The mode of withdrawal is worth recording. A grasshopper is hanging by a hind leg. Its whole body, except the antennæ, is already free from the skin. At the moment these organs are being detached. The grasshopper swings from side to side as though trying to shake itself free from an encumbrance. I then see it take an antennæ in its jaws, grip it by its base which is partially withdrawn and gently pull it down from its case. Having done this, it takes another purchase, grips the thread a little further up, draws it down another stage. The same operation is repeated, until by a series of these gentle tractions the delicate thread is hauled from its tube. The whole filament comes out entire and is lowered out of harm's way. The act is then repeated on the opposite side, and by a similar machinery of traction the other antenna is hauled out.

Another feature that deserves attention is the final disposal of the skin. I have never seen the act inside a cage but it happens in the open air where the insect lives a free life. Here is one of half a dozen instances. A full-grown grasshopper has just emerged : its skin is alongside it stuck to a stem. The grasshopper hangs with its back downward. Its antennæ are widely stretched sawing and sensing the air. Soon I see it nibble at the skin. At first I thought the act just a bite of curiosity, but very soon it becomes clear that the insect intends to eat up its skin. It commences operations at one of the wings, quickly chews up this fragile material and grinds it into a soft pulp. This wing is finished in about a minute. Then it goes to the opposite side and the other wing follows equally fast. The head and thorax are next attacked. These, being thicker, must be chewed more thoroughly. Nevertheless, they too disappear. The abdomen then meets with attention. This is a soft bit and gives little trouble : a few bites and down it goes. Now only the leg integuments remain. The front and middle legs went down with the thorax ; but the long stout hind legs have not yet been touched. The sheaths of the shanks are swallowed easily enough. I thought that the glutton would go no further. The rest of the leg looks a formidable morsel. The tibia is stiff with projecting spines ; the tarsus has sharp claws. But the grasshopper did not reject even these things. Taking them between its jaws, it cut them in pieces, macerated the fragments and ground them into pulp. It was a much more tedious operation than the swallowing of the softer shanks. The consumption of a leg took five minutes. Spines, joints, claws, every bit of it, went down in the general gorge. The whole deglutition lasted forty minutes. There was no cessation from beginning to end. In the end not a trace was left. All had again returned to the owner who kept hanging to the stem digesting its gorge.

What excellent examples of strict economy do we not find in Nature's works ? Papilio caterpillars, after leaving the egg, eat up the empty egg-shell before starting on the leaves. Geometrical spiders, when their snares are in fragments, first eat up the broken fabric, then rebuild the snare. Nature will not waste anything if it can have further use. A locust's skin must be cast off. Does it not seem a wasteful operation? Would it not be a much better plan for the skin to regularly expand? No; there is no waste. The grasshopper's sheddings return to their owner. They are ground again into digestible material, taken up in the chemical machinery of nutrition, assimilated into living substance, perhaps built up into a new integument which replaces that which was lost. Thus there is no extravagance nor waste. What appears rejected is just temporarily laid aside. Everything again becomes living tissue in the wonderful and economical machinery of life.

The grasshopper, now the image of a leaf, lives only in leafy haunts. It is quite independent of its own companions, no longer goes to the ground or the tree-trunks, nor takes any notice of the ants. It lives in the open, on the surface vegetation. As a rule it sits absolutely motionless with its veined wings blending with the leaves, and its legs stiff like the rigid stems. The only trace of movement comes from the antennæ, just a quivering that can scarcely be seen. Yet often these antennæ first attract attention, not because they are conspicuous, but because there is nothing quite like them on the tree. The grasshopper behaves as though it realized that its safety depended on remaining still. All its actions are exactly chamaeleon-like. When it moves, it does so with the greatest circumspection, climbing in a slow and stealthy manner, stepping craftily from leaf to leaf as if fearing to attract an enemy's eye. Even in a cage it is difficult to see when mixed up with its accustomed leaves. At night it shows greater activity. Its natural enemies have then retired. Hence it climbs about fearlessly on the tree, feeds voraciously on young shoots and flies off to find new haunts.

Though at first difficult to find, yet as the eye gets trained with practice the insect can more easily be distinguished from the leaves. This may seem a very trivial observation, yet it is important to remember that greater powers of detection follow from frequent efforts to detect. Certain naturalists can scarcely believe that some of the most perfect examples of resemblance can have been developed for protective reasons. The resemblance, they consider, is too exact. Take, for instance, the Kallima butterfly. Its likeness to a withered leaf is marvellous. The superficial veinings, the holes that correspond to insect-borings, the varied pattern like a living fungus, all seem to be unnecessarily exact. Would not a general similarity have been sufficient? Why identity in the minutest points? But we must not forget the slow growth of this perfection. Also that as the resemblance got closer, at the same time the skill in detection improved. The two work against one another. Continual practice improves detection. This again makes the resemblance improve until the minutest perfection results.

The adult grasshopper has good flight, swift and straight, not great in extent, yet sufficient to carry it from bush to bush. The act demands considerable effort. All we see is a haze of wings as the insect shoots off through the air. Its leaping powers are good also, though not equal to the short-horned locusts. But it has a peculiar faculty of shooting off in an unexpected direction, often making a dive to the ground or into the thick of a bush. In fine weather it keeps on the open vegetation, but during rain it gets under a leaf. The antennary quivering never ceases. Its mouth parts too are incessantly in action, repeatedly polishing the palpi and lips. It is very attentive to certain parts of its body. For example it frequently licks its paws. Also it polishes the stick-like legs, and sometimes bends its head to its tail in order to give the ovipositor a rub. Though nibbling slowly, yet it feeds continuously, eating away the leaves from the edges after the manner of the locust tribe. Night and day it attacks the foliage, especially the youngest and tenderest shoots which it finds at the tips of the stems. When alarmed, it is instantly alert. Raising itself, it shoots out its antennæ and uses them as arms to grope the air. Often one antenna is thrust to a flank while the other is directed ahead. The attitude seems strikingly unnatural, yet it shows how the thread-like callipers investigate on every side. All the time they are extended their tips are quivering. Then comes a sudden jump, and the grasshopper is on another leaf.

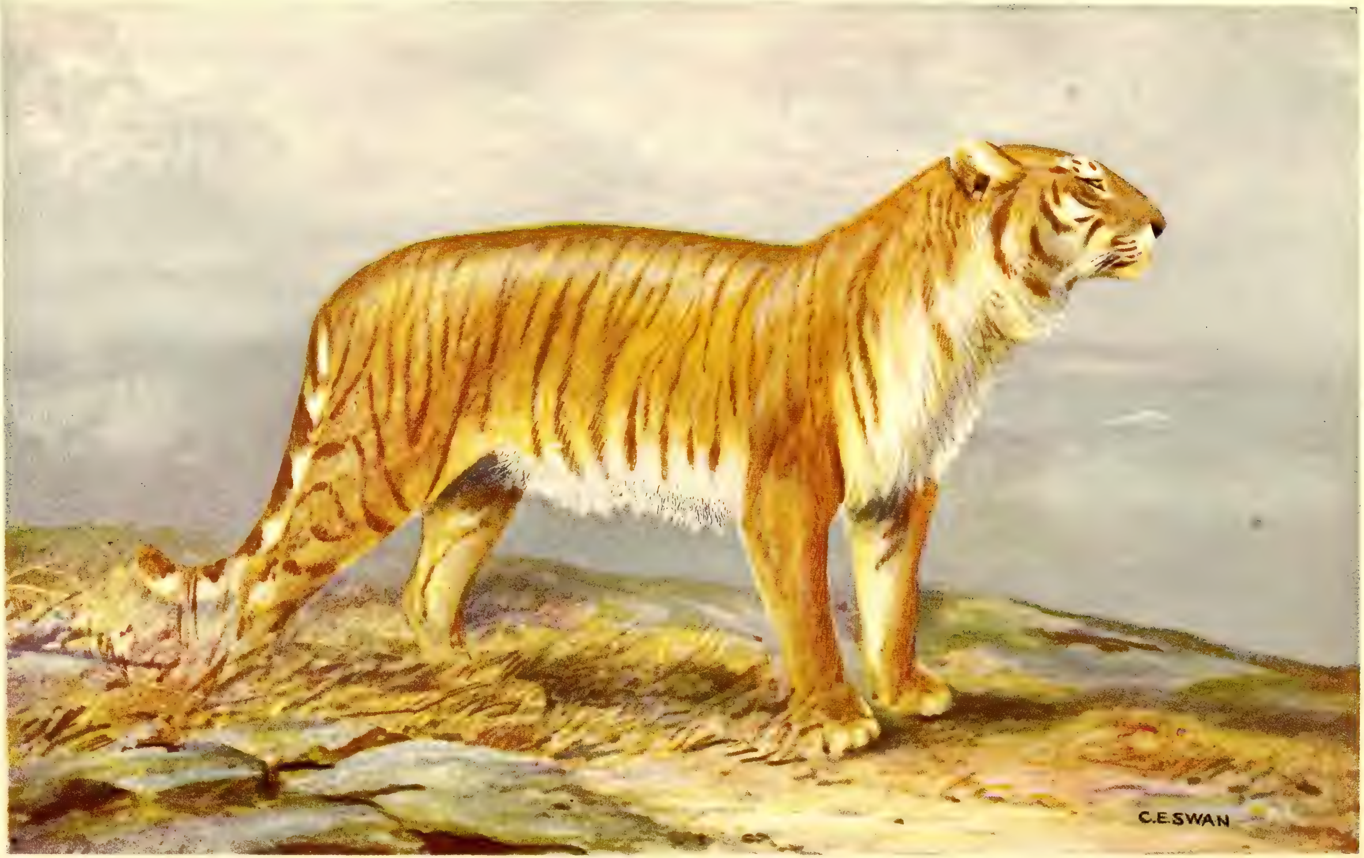
So far as I know it is strictly herbivorous. In this district I find it on the leaves of the Bael and the tenderest shoots of *Inga dulcis*, common as a garden hedge. These it devours with the greatest eagerness but refuses the older leaves. I also find it on the *Falsa* and *Ber* and many garden shrubs. In a cage they ate a variety of plants, also nibbled at a guava, but not a plantain. They absolutely refused to eat the grass that sprang up on the floor of their cage. Also they would have nothing to do with any kind of animal food.

I never caught them in the act of pairing. It must have taken place amongst those in my cages, for on two occasions I saw a female dragging behind her the product of this act. A gelatinous globule hung from her ovipositor. It was spherical and about the size of a pea. This was the spermatophore, a delicate structure extruded by the male. In the form of an opalescent bag, it remained sticking on to the female, and she carried it with her wherever she went.

Nor was I able to observe the egg-laying. The females refused to oviposit in confinement. But an allied species *Phaneroptera roseata*, Walk, showed me how it probably took place. I see a female of this species at the edge of a leaf. She holds it, with a fore leg on either side. As well as I can see through the screen of vegetation she grips the edge of the leaf in her jaws. Her next act is to insert her ovipositor. She pushes it into the edge of the leaf. Extrusion of the egg immediately follows. Then the ovipositor is withdrawn leaving the egg inside in the leaf. The weapon is then brought to the insect's mouth. There it is given a careful polish in preparation for the next thrust. The whole operation is very precise. Take a knife and try to push it into the edge of a leaf. The manipulation will require some nicety of action even in the human hand. Yet the grasshopper does it with perfect ease, her jaws and fore legs steadying the leaf and holding it to receive the thrust.

The egg itself is a flattened scale one-eighth of an inch long. It looks like a fresh seed taken from a leguminous pod. Being flat and oval, it is easily inserted, slipping in between the layers of the leaf with little or no swelling evident from outside. Three or four are placed along the same edge, evenly separated from each other, indicating the rhythmical movement of the ovipositor at the time when the eggs were introduced. There is nothing evident from the outside beyond just a slight swelling and a paleness on the surface of the leaf.

I have not observed the hatching nor the insect at its earliest stage. This is a serious gap in its history. However we have seen the most interesting points : how an insect at one time mimics an ant and at another time mimics a leaf. Such an occurrence almost sounds incredible. Yet there exist parallel instances. Mr. Uvarov has described a wonderful example in the transactions of the Entomological Society for the year 1922. It relates to *Leptoderes ornatipennis* from Java, which first mimics a Tiger-beetle of the genus *Collyris*, at a later stage another Tiger-beetle of the genus *Tricondyla* and ends by resembling a green leaf. Again we have the African *Eurycorypha*, which runs very parallel to my Indian example, in that it begins by mimicking an ant and ends by resembling a leaf. What name are we to give to this remarkable change, this transition from one kind of resemblance to another ? Professor Poulton makes the best suggestion in the Proceedings of the Entomological Society for the year 1922. He proposes the expression 'Transformational mimicry', an expression which gives us a clear idea of the extraordinary change involved.



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TIGER FROM NORTHERN SLOPES OF ~~CAUCASUS~~ ELBURZ MOUNTAINS.

TIGERS

BY

R. I. Pocock, F.R.S.

Temporary Assistant in the Zoological Department of the Natural History Museum

(*With 1 coloured and 12 black and white plates*)

INTRODUCTION

The collectors employed by the Mammal Survey of India, organized by the Bombay Natural History Society, received general instructions to pay attention particularly to the smaller animals and to leave ' big game' alone so as not to trespass upon the province of the sportsman. In a measure this is a matter for regret, because there is still much to be learnt about big game which will be the first to disappear from the fauna of India with the steady encroachment of man on the wilds; and this applies in particular to the tiger against which every man's hand is turned. The result of the instructions above referred to was the practical absence of spoils of the tiger from the collections secured by the Survey;[1] and since sportsmen very naturally like to preserve for themselves such handsome trophies as tigers' skins, the material of skins of this species from India in the Natural History Museum can almost be counted upon the fingers of two hands. This, with a few Persian and Manchurian skins, is a very small number upon which to come to definite conclusions with regard to the number of local races that may exist and the range of variation in size, pattern, colour and other characters upon which the admitted local races have been established. Of these there are some four or five, namely, the Mongolian, Persian, Indian and Sunda Islands races. But there is evidence for the existence of others, without the possibility of defining them owing to the absence of properly localized material. Even within the precincts of peninsular India, it is known that tigers vary to a certain extent locally according to environment; but information on this point, although full of interest, is at present very vague.

The main purpose of this paper is to summarize the characters of the tigers of different countries, so far as the limited material at my disposal admits; and to show incidentally the defects in our knowledge in the hope that sportsmen may realize that the National Collection at South Kensington is badly in need of skins and skulls of tigers from all the districts of the world where these animals are found.

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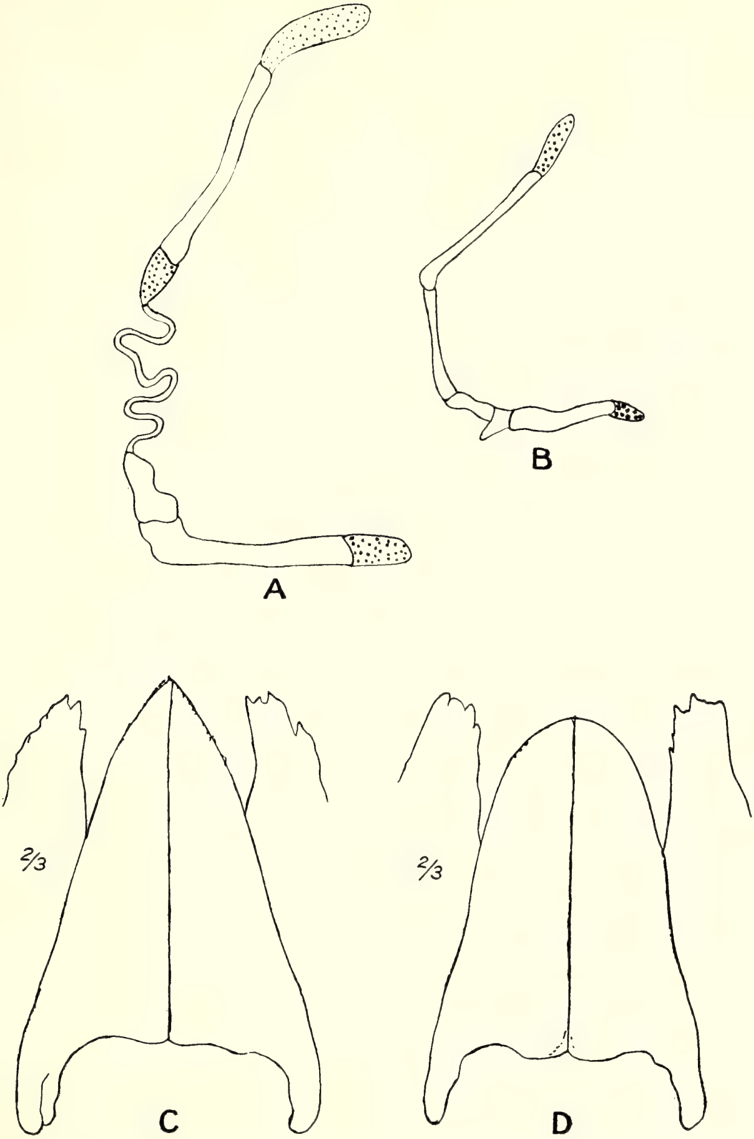
[1] Two, which would have been particularly interesting to me, namely one from Jog in Southern India and one from Tenasserim, were not forwarded to the British Museum.

THE NAME OF THE TIGER AND ITS KINSHIP WITH THE LION

In the first place it is necessary to explain my use of the name *Panthera* for the tiger instead of *Felis* which will be familiar to most readers of this Journal. The type of the genus *Felis* is the common house cat (*F. catus*); and in the strictest sense in which *Felis* is now employed, it is limited to that animal and its near allies, the European wild cat (*F. sylvestris*), the North African and Asiatic wild cat (*F. ocreata*), the Indian desert cat (*F. ornata*) and a few others. But years ago the old naturalists perceived vaguely that the Felidæ or Cats of the world fall into several definite groups for which they proposed a number of generic names, without being able to lay their hands upon satisfactory characters to justify that course. One of these names was *Panthera*, given to the leopard. Now the leopard, jaguar, tiger, lion and snow leopard differ from all the other groups of Felidæ in a very interesting character. In the typical Cats the hyoid bone which strengthens and supports the larynx, or organ of voice, is held close to the base of the back of the skull by a series of short bones jointed end to end. But in the tiger, lion, leopard, jaguar and snow leopard, this series of bones is imperfectly ossified and largely replaced by a long elastic ligament, so that the larynx has great range of movement which is connected in some way with the voice. I do not know the voice of the snow leopard; but the roars of the lion, tiger and leopard or panther, are well known to all Indian sportsmen. These species, moreover, do not purr when pleased or in an ingratiating mood. In all the other Cats, including the hunting leopard, the sexual call is different from the deep-toned roar of the leopard-group and a feeling of content is expressed by purring. (Pl. A, figs. A, B.)

It was Richard Owen who in 1834 first pointed out this structural difference between the hyoid bone of the lion and some other members of the Cat family and correlated the modification with the difference in voice. In the case of the lion he stated that the suspensory ligament of the hyoid is six inches long and is capable of stretching to nine inches.

The tiger's hyoid is similar to the lion's and the roars of the two species are unmistakably alike in depth of tone. I have more than once heard people at the Zoological Gardens in London exclaim on hearing a tiger roar: 'Oh, listen to the lions roaring!' It is true that tigers never, in my experience, roar in chorus, and that the roar is, I believe, almost entirely a sexual call, consisting of a single intonation which may be repeated after an interval, but is never repeated in rapid succession with the head stretched forward in a line with the back as is the case with the lion. Now voice in animals is in nearly all cases a good indication of affinity; and no one who realizes this fact can doubt that the lion and the tiger are nearly allied forms, more nearly allied indeed than either is to the leopard or jaguar. The affinity, indeed, between the two giants of the Cat tribe needs to be insisted upon because an eminent American mammalogist recently defended his adoption of the generic name *Leo* for the lion and *Tigris* for the tiger because of



A. Left side of hyoid of Tiger (*Panthera*) showing ligament, shortened and thickened by methylated spirit, joining the upper and lower bones.

B. The same of domestic cat (*Felis*), on larger scale, showing continuous series of bones.

C,D. Nasals and summit of maxillæ of Lionesses from Mulema and Barengoland, E. Africa, showing intergradation with those of tigers.

'the well-known differences between the two'; but he made no attempt to state what the differences are.

In its general reddish colour, relieved by black or, in parts, brownish stripes, white patches over the eyes and white under side, a typical tiger differs markedly from a lion ; but the pattern of some lion cubs is very tiger-like as I have elsewhere shown (*Ann. Mag. Nat. Hist.* (7), xx, p. 437, 1907) ; and in the Sumatran tiger, described below, the white is much less conspicuous than usual and is even tinged with buff. Moreover, the Caspian tiger, also described in this paper, with all the normally black stripes brown and only a little darker than the ground colour, probably represents the stage passed through by the lion when losing his pattern. Hence in tigers occur variations from the normal pattern in the partial suppression of the black stripes and white areas approaching the uniform tint of the lion and showing that the differences between the two species in this particular are not of fundamental importance.

The mane, moreover, of the male lion is not a distinctive feature. It varies enormously within the species and may, indeed, be absent, as recorded by Col. Patterson of the man-eating lions of Tsavo. On the other hand, even Indian tigers sometimes have a distinct mat-like mane on the nape and in the old male Javan tiger recorded below the mane was as large as in many lions. I at one time thought there was a constant difference between lions and tigers in the direction of growth of the hair on the neck, that of the tiger growing backwards at least on the nape, whereas in the lion, as in the leopard, it streams forwards from a whorl on each side in front of the shoulder, the two streams meeting in the middle line of the nape to form a median crest, where the mane begins. But I find that tigers show great variation in this particular, the hair-growth in some specimens closely approaching that of the lion.

Again, if it be claimed that the lion is distinguished by having a black tuft at the end of the tail, it need only be pointed out that the size of this tuft is very variable and that it may be reduced almost to vanishing point.

From my observation of living animals I should say that a tiger has a more springy gait than a lion, with the back less straight and the loins decidedly weaker at least as a general rule ; but both species vary a great deal in build and the differences are not of much importance.

As regards the skulls of lions and tigers, Blanford (*Fauna of British India : Mammalia*, pp. 56 and 59) gave two paragraphs to the points by which he thought they might be distinguished. But the examination of a larger series would have shown him the inconstancy of most of the characters he relied upon. Typically a tiger's skull is elevated above the orbits so that its upper profile is much more arched than that of a lion's skull which is manifestly flat in comparison. This difference in the shape of the head is usually very obvious in living animals. But the tiger's skull from Deli in Sumatra, described below, is as flat as any lion's ; and if it be claimed that this peculiarity is due to the animal being reared from cubhood in captivity, I may add that the skull of the tiger from Sungei Kumbang in Western Sumatra, obtained by Robinson and Kloss, is as flat along the top as the skull of many lions. (Pl. B.)

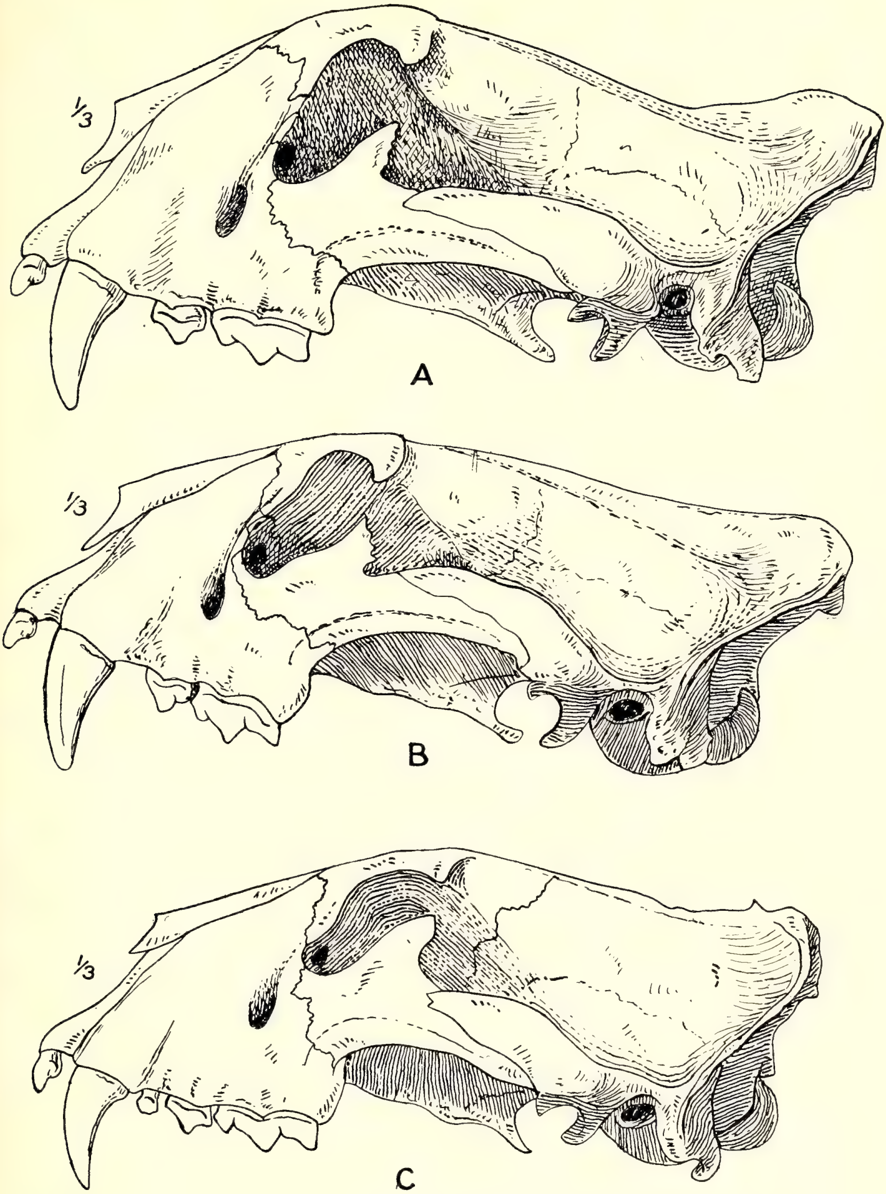
So, too, with the nasal bones. Typically in tigers' skulls the posterior ends of these bones project backwards in the middle line some distance beyond the maxillary bones which flank them at the sides, whereas in lions' skulls the ends of the bones in question are approximately on a level, the nasals being sometimes shorter. But the width and length of the posterior ends of the nasal bones in tigers' skulls are extremely variable as the sketches in this paper show, especially the sketches of these bones in the skull of an adult tiger from Nepal and another from Darjiling, which for geographical reasons may be assigned to the same race. The upper ends of the maxillæ in these skulls are also different, the Darjiling skull being much broader in the interorbital region than the one from Nepal. Again in the skulls from Mergui and from Sungei Kumbang and Deli in Sumatra, the nasal bones only overlap the maxillæ to a very slight extent, and show a complete gradation to the leonine type as also do the Sumatran skulls in the relative length and width of the nasals. For example, in the Sungei Kumbang skull the greatest width of the nasals by the nostrils is much more than half their length, whereas in the skull from Nepal the width is considerably less than half the length. (Pls. A c. & d; C a. & c, Ic.)

I find similar variations in the bones forming the roof of the posterior nostrils—a character which Blanford mentions as distinctive. All indeed, that can be said with regard to the cranial differences between these two species is that tigers on the average have more vaulted skulls, with longer, narrower nasal bones, narrower anterior nares, the facial part shorter as compared with the cranial part and the lower edge of the mandible straighter than in lions.

My purpose in pointing out these resemblances between the lion and the tiger is strongly to protest against the view that the differences are sufficiently important to justify their assignment to two distinct genera and to support my own opinion that they are merely two well-marked species of the genus *Panthera*. And since tigers, wherever found, are obviously the 'same' animal, I regard the different kinds that have been described merely as local races, or subspecies, and not as distinct species under the names *Tigris tigris*, *Tigris amurensis*, *Tigris sondaica* etc., as is done by the Russian Zoologist, Satunin, and some other authors quoted in the Synonymies given below.

The Distribution of the Tiger in the Past and Now

Skeletal remains of tigers indistinguishable from the existing species have been found in Pleistocene deposits in northern Siberia even as far to the north as the New Siberian Islands in the Arctic Ocean, well within the Arctic Circle, north of latitude 70° and far to the north of the animal's present range. They were associated with the remains of the elk, reindeer, Persian red deer (maral), musk ox, saiga antelope, horse, brown bear, polar bear, Arctic fox and



A. Skull of Tiger (*Panthera tigris tigris*) from Central Provinces, showing typical shape in the Indian race.

B. Skull of Sumatran Tiger (*Panthera tigris sumatræ*) from Sungei Kumbang, showing likeness to the Lion's skull.

C. Skull of Lioness from Mulema, Uganda, for comparison with A, B.

wolf which are still in existence, and of a bison, the mammoth and woolly rhinoceros now extinct (Tscherski, *Mem. Acad. St. Petersburgh*, vol. 40, 1892). From the nature of this fauna of nowadays mixed temperate and northern types, it must be inferred that northern Asia throughout Pleistocene times was free from the glaciation which supposedly affected other parts of the hemisphere and supported a rich vegetation of grass, shrubs and trees supplying food for the Ungulates upon which the Carnivora preyed, and that the present arid, inhospitable condition of the country, with its rigorous climate, is of comparatively recent date (Hinton, *Proc. Yorkshire Geol. Soc.* 1926).

Since the bones above referred to are the earliest known remains of the tiger, it may be concluded, as a working hypothesis, that central and northern Asia was the original home of the species; and this conclusion helps us to understand the distribution of the species at the present time. It survives in Mongolia, Amurland, Manchuria and Corea, its most northern districts; and in the south-west of Asia, from the Russo-Afghan boundary, to the north of the Hindu Koosh, through the Elburz mountains, south of the Caspian, as far as the eastern portions of the Caucasus. There is evidence that the tigers of the Perso-Turkestan district are, or were, continuous in their distribution with those of Mongolia; and from the occurrence of tigers in northern China and southwards, there is no doubt of continuity in the distribution of the species in eastern Asia from Manchuria southwards. From South China, tigers extend through Burma, Siam and the Malay Peninsula into the Sunda Islands of Sumatra, Java and Bali, but not into Borneo,[1] Bali being the limit of the range of the species in south-eastern Asia.

Since tigers are not found in Tibet or on the northern slopes of the Himalayas, and since those of Burma and Assam seem to be the same in all essentials as those occurring on the southern slopes of that mountain range, it may be inferred that the species entered India from Burma round the eastern end of the Himalayas and travelled thence westwards along those mountains through Bhutan and Nepal and in Peninsular India reached as far as Gujerat in the west and Cape Comorin in the south, arriving at the latter point too late to get into Ceylon. This view of the route by which the tiger gradually spread over India is borne out by several facts. Major Burrard, for instance, states that in the Himalayas tigers are more numerous to the east of the Bhagirathi river, a tributary of the Ganges, than to the west of it (*Big Game Hunting in the Himalayas and Tibet*, p. 243, 1925). Moreover, the tigers of the Perso-Turkestan district are somewhat different from those of north-western India and were doubtless excluded from India by the Hindu Koosh and the desert areas of Persia and Baluchistan.

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[1] The idea that the tiger exists in Borneo is perhaps due to the record of an old skull, ticketed Borneo, in the British Museum. This skull, judging from its size and shape, is that of an Indian tiger.

The Size of Tigers

Height.—In Rowland Ward's Records there are a number of estimated heights of Indian tigers.[1] These range from 3 ft. 3 ins. (39 ins.) to 4 ft. 2 ins. (50 ins.), the latter measure being taken from a skin from Seonda measuring 10 ft. 3 ins. in total length, a good but not very exceptionally large specimen. It is stated, moreover, that the Maharajah of Cooch Behar measured a tiger standing 3 ft. 10½ ins. (46½ ins.) at shoulder. It is not explained how this measurement was taken.

When I was Superintendent of the Zoological Gardens in London I measured many tigers by means of a graduated scale on the front of the cage. By watching the animals standing alongside or passing this scale day after day it was possible to judge their actual standing height with tolerable accuracy, most certainly well within 1 inch. The largest tiger in the Collection was a Manchurian specimen, and all the Indian sportsmen, acquainted with tigers, who saw him, agreed that he was a splendid animal. Yet his standing height at the shoulder was only just about 3 ft. 2 ins. (38 ins.). That is to say, he was 8½ ins. lower than the Indian specimen measured by the Maharajah of Cooch Behar, 1 in. lower than the smallest of the tigers whose estimated height is published in the Records and exactly 1 ft. (12 ins.) lower than the largest of those, namely, the tiger from Seonda! This measurement may, however, be reasonably set aside as due to the inadvertent addition of 1 ft. to the animal's stature; and the estimated measurements may be neglected as such. But the case of the tiger with the alleged standing height of 3 ft. 10½ ins. is on a different footing. Personally, I reject it without hesitation; and for the following reason. A good Indian tiger stands just about 3 ft. at the shoulder and measures about 10 ft. long from nose tip to tail tip. That is to say, his length is roughly 3⅓ times his height. Judged by this method the Manchurian tiger standing 3 ft. 2 ins., above referred to, measured about 10 ft. 7 ins. long, a reasonable estimate. But by the same standard the tiger stated to have been 3 ft. 10½ ins. at the shoulder was close upon 13 ft. long, which, as every sportsman knows, is a preposterous supposition.

Length.—The lengths of tigers have been discussed *ad nauseam* and I have nothing to add here to what has already been written by competent sportsmen on this subject, except to say that what is required for a correct understanding of the variations in the size of tigers are accurate measurements of properly sexed, adult individuals, whether large or small, from as many localities as possible. From the scientific standpoint small tigers are quite as interesting as large tigers.

Very useful tables giving the dimensions of Indian tigers may be found in Rowland Ward's Records. Particularly interesting is the table (p. 474, ed. 1928) compiled by Sir J. P. Hewett, who states that out of a total of 250 specimens he has seen shot only eight tigers ranged from 10 ft. and ½ an inch to 10 ft. 5½ ins. and only seven tigresses were between 9 ft. and 9 ft. 3 ins. It will be noticed that all the tigers were from Naini Tal or Garwhal and five of the tigresses from the same places; one from Bijnor and only one, the smallest, from as far south as Hoshangabad in the Central Provinces. But what of the remaining 235 specimens? Are we to infer that all the tigers of Naini Tal are large? Or did any of the smallest come from that locality as well? Those are the kinds of facts one wants to know.

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[1] It is not quite clear whether these heights were taken by the owners in the field from the dead body or from the stripped skin.

White, Red and Black Tigers

Apart from comparatively slight individual or local variations of the normal type of colour, tigers sometimes exhibit striking variations due to suppression of pigment resulting in so-called white tigers or to development of pigment resulting in black tigers.

So-called white tigers are particularly interesting from the different grades of albinism they show. Of these three types are known.

1. Tigers in which the red pigment is abstracted from the ground colour leaving it cream or white with the stripes standing out boldly in 'dark brown', 'chocolate' or 'reddish black' as observers have described. To this, the commonest, variety belong a white tigress from Orissa (*Journ., Bomb. Nat. Hist. Soc.*, vol. xix, p. 744, 1910); a tiger from Bilaspur (*Journ., Bomb. Nat. His. Soc.*, vol. xxiv, p. 819, 1916); a tiger caught alive in the jungles of Sohagpur (*Journ., Bomb. Nat. Hist. Soc.*, vol. xxvii, p. 932, pl. 1921); and a few recorded from Rewa. Of these there is in the British Museum a mounted specimen deposited by H. M. King George V, to whom it was presented by the Maharajah of Rewa.
2. Like those of the first category but with the black pigment of the stripes diluted to tan. I am only acquainted with one example of this type, namely, a skin from Mirzapore presented to the British Museum by Mrs. Craigie Halkett. This type is intermediate between the first category and the one that follows.
3. Tigers exhibiting the extremest stage of albinism, pigment being absent not only from the ground colour but also from the stripes. Of this type I am only acquainted with one record, namely, a tiger exhibited in about 1820 in the Exeter Change and figured and described by Hamilton Smith. In this animal, the locality of which is unknown, the stripes were only visible in certain lights, as in the case of some albino tabby cats. J. G. Wood also described it, with a figure not taken from life, in the first volume of his well-known Natural History, 1861.

Other white tigers which cannot be classified owing to absence of particulars have been recorded, namely, one, presumably from Poona, by Howard Saunders (*Proc. Zool. Soc.* 1891, p. 373); two tigresses from Bhagalpur, and two tigers from the Central Provinces, one being from Korea (*Rowland Ward's Records*, 1928, p. 478).

Possibly the red tiger, illustrated in our coloured plate and recorded below under the heading *Panthera tigris septentrionalis*, should come into this category of aberrations. It is a unique type with all the black pigment abstracted from the stripes, leaving them reddish-brown and only a little darker than the ground colour.

Black tigers are much rarer than white tigers. There appear to be only three records. Blanford, in his volume on the Mammalia of the Fauna of British India Series, refers to one seen in Chittagong by Mr. C. T. Buckland in 1846. A full account of the incident was published in the *Field*, vol. 73, p. 422, 1889. The animal was found dead, killed by a poisoned arrow, and decomposition was so far advanced that the skin could not be saved. A second was seen near Bhamo and wounded but made its escape, leaving its pug marks as evidence that it had not been mistaken for a large black leopard, as recorded by Mr. Hauxwell (*Journ., Bomb. Nat. Hist. Soc.*, vol. xxii, p. 788). The third, found dead like the first, was seen in the Lushai Hills; but in this instance also the skin could not be saved (*Field*, 1928, p. 656).

It is interesting to note that these black tigers all came from localities, tolerably near at hand, to the north-east of the Bay of Bengal; and it is significant that black leopards are far more plentiful in what was formerly called Further India than in Peninsular India.

Indian Tigers

Before the existence of local races, or subspecies, of tigers was established, the name *Felis tigris* was applied in a comprehensive sense by early writers to tigers in general. But the subsequent admission of the occurrence of geographical races and their designation by distinguishing titles necessitated the restriction of *tigris* to one particular form. In this matter I follow the opinion expressed by Oldfield Thomas in his paper on the Mammals described by Linnæus in the 10th edition of the *Systema Naturæ*: 'Later revisers of the races of tigers, of whom Fitzinger and Matschie may be specially quoted, have restricted *F. tigris* to India proper and particularly Bengal' (*Proc. Zool. Soc.*, 1911, p. 135). The Bengal tiger, therefore, becomes the representative of the race *Panthera tigris tigris* and the example in the Natural History Museum, ticketed Bengal (Col. Sanderson), which is described below, may be regarded as a topotypical specimen of it. It is important to bear this in mind in view of the possibility of the admission of other Indian races in the future. At present, however, I refer all Indian tigers to the same race, the name of which, with its principal synonyms, is as follows:—

Panthera tigris tigris, Linn.

Felis tigris, Linn., *Syst. Nat.* ed. 10, p. 41, 1758; and of most authors who have written on Indian tigers, including Blyth, Jerdon, Blanford and others.

Tigris regalis, Gray, *Cat. Mamm. Brit. Mus.*, 1842, p. 40; also of some other authors, including Hodgson.

Tigris striatus, Severtzow, *Rev. Mag. Zool.*, 1858, p. 386.

Type Locality. Bengal.

Distribution. India from the southern slopes of the Himalayas to Cape Comorin; also some of the countries to the east of the Bay of Bengal.

The names *regalis* and *striatus* were proposed respectively by Gray and Severtzow because, adopting *Tigris* in a generic sense, they thought they had the right, not now admitted, to alter the specific name to suit their personal dislike of identity between the generic and specific titles of an animal.

SKINS OF INDIAN TIGERS

I have already referred to the vagueness of our knowledge of the local, seasonal and individual variations in colour in Indian tigers, although it seems to be generally agreed that such variations occur. For instance, Major F. G. Alexander, writing on this subject (*Harmsworth's Natural History*, vol. i, pp. 378–379, 1910) says :—'My field of observation has been limited to Rajputana, Central India, and Bundel Khand, the jungles in which may be called "open jungles". The colour of all the tigers killed by myself and by brother sportsmen was, with two exceptions, "a light red ochre." One exception was a tiger, lured from a cave in the Asseerghur jungles, whose colour "was dark red ochre, far darker than that of any tiger I have ever killed."' Another interesting variety he described as follows :—'I have killed tigers during the hot weather, monsoon and cold weather; and as regards the length of their hair, I have found very little difference between a cold-weather tiger and a hot-weather tiger. There was, however, one exception. This was apparently a very old male, measuring only 8 ft. 1 in., shot in Pertaburgh territory within 20 miles of Neemuch; his fur was quite an inch long all over the body; his colour was ruddy ochre, the ruff round the neck was particularly full and his whole appearance led me to regard him as a dwarf-like specimen. If the skin had been exposed for sale in a furrier's shop, it would have been accepted as a Chinese or Siberian specimen.' These are interesting instances of individual variation. As regards environmental varieties, Major Alexander says :—'There is no doubt that in dark jungles, such as those of the Siwaliks or the Dun forests, animals' [tigers'] skins assimilate themselves to the localities . . . but in open jungles the pigment of the tiger's skin is invariably light. The Beemashunker, Kanara and Belgaum jungles contain darker-coloured specimens, and I have seen skins from them all which were, on the average, far ruddier than the thirty-one I have obtained and a dozen more which I have seen killed.'

I have selected these extracts at random from a volume that happened to be at hand, not doubting that other Indian sportsmen have published similar experiences. But the observations recorded require to be amplified and extended to all parts of India if the tigers are ever to be known as some of the groups of smaller mammals are now known, thanks to the Survey carried out by the Bombay Natural History Society.

Owing to the scanty material at my command I can contribute very little to this end; but possibly the subjoined brief notes on the skins in the British Museum may be useful in a small way as a basis for further observations which so many Indian sportsmen have the opportunity for carrying out. Such information would be much more interesting and important than records of weights and measures.

In the first place my experience with living tigers, when I was Superintendent of the London Zoological Gardens, confirms Major Alexander's observation regarding the absence of any marked seasonal change in colour or thickness of coat in Indian specimens, whether they come from Nepal or Mysore. That the absence of such change was not attributable to their conditions of life in England was shown by a pair of Manchurian tigers which with perfect regularity donned a thick winter coat during the ten years they were under my charge. But there may be parts of India in which seasonal changes do occur.

The skins in the Museum are as follows :—

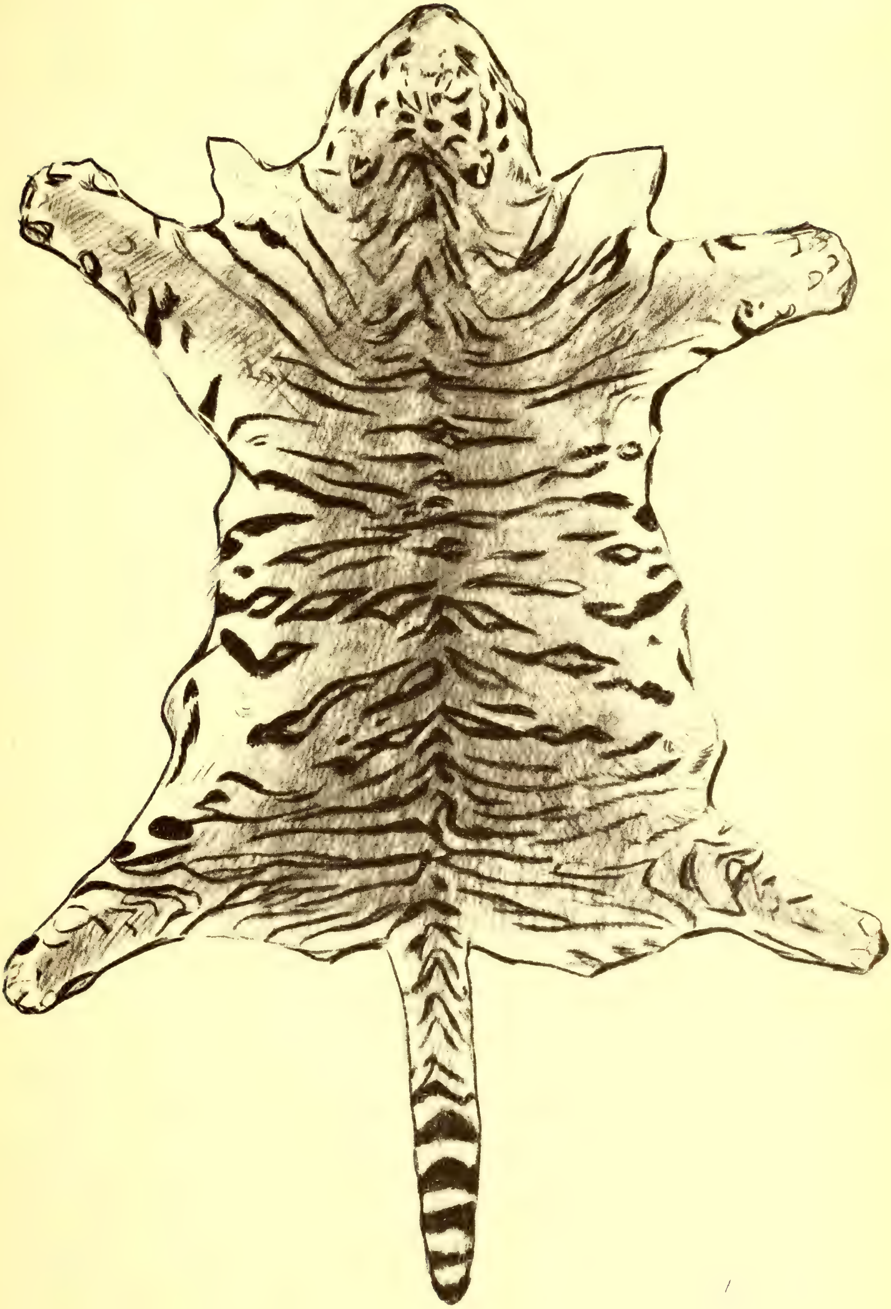
1. *Nepal.*—A mounted tigress presented by King George, is a normally coloured, fully striped, rather rough-coated specimen, differing very considerably from a couple of tigresses from the same country presented to the Zoological Society by the King, when Prince of Wales. These tigresses were short and smooth coated throughout the year, although kept in the open all through the cold weather. They were remarkable for the reduction both in number and length of their stripes, of which scarcely any showed signs of looping. The greater part of the shoulder, the outside of the fore leg and a large area of the side of the body behind the shoulder were without stripes, and, except at the very base, there was only one stripe on the inner side of the fore leg. On the hinder part of the body the stripes were comparatively thin and widely spaced. I published a photograph of one of these tigresses, which were probably from the same litter (*Proc. Zool. Soc.*, 1908, p. 892) and photographs of one or the other may be seen in *Harmsworth's Natural History*, vol. i, pp. 373, 374, 378. It would be particularly interesting to know if these two different types of tiger occur under the same or different conditions in Nepal. (Pl. D, upper fig.)

2. *N. W. Provinces.*—A mounted tiger, presented by P. Wyndham in 1903, is a short-haired, very handsome large specimen, richly coloured, but not dark, and well marked with broad, black, looped stripes.

3. *Bengal.*—A dressed skin of a tiger, presented by Col. Sanderson, closely resembles the last in coat, colour and pattern. The skull belonging to this skin is one of the largest in the collection, but the dressed skin measures just under 10½ feet. (Pl. II.)

4. *Mirzapore.*—A dressed skin of a white tiger with tan stripes, presented by Mrs. Craigie Halkett. It is just under 10 feet in length and is approximately similar in pattern to the skin from Bengal.

5. *Rewa.*—A mounted white tiger, with deep chocolate stripes, deposited by H. M. The King, closely resembles the last two in the extent, spacing and formation of the stripes.



SKIN OF BENGAL TIGER.

6 and 7. *Chota Nagpur.*—The dressed skins of two tigresses, from Palamau, presented by Capt. S. N. Walker, are not so brightly tinted as the Bengal Tiger, but since they had been made up as rugs, their paler hue is very likely due to exposure to light. The stripes show pale ticking. Otherwise they are well defined. One skin, however, has a bolder pattern of broader stripes than the other and is altogether handsomer. They measure respectively 9 ft. 8 ins. and 9 ft. 5 ins., but the head and body of the latter are 6 ft. 8 ins., its inferiority in total length to the other, which has a head and body length of 6 ft. 3 ins., being due to the incompleteness of the tail.

8. *Guzerat.*—The flat skin of a young tiger obtained by Major B. H. O'Donnell at Dunta in Palanpur is pale in colour, with spaced, looped stripes, but the loops are short. On the croup the stripes fuse dorsally on each side, leaving a narrow longitudinal pale area nearly as well defined as in the skins of the Persian and Afghan boundary tigers described below.

9. *Thana.*—The flat skin of a full-grown tiger, shot by Mr. T. B. Fry in ' open ' jungle, about 40 miles north of Bombay, is rather like the Palanpur skin but is still paler, the general hue being tawny and everywhere blending with the white. The white on the belly is extensive, the two combined about equalling the tawny area between them. The skin measures only 8 ft. 7 ins., of which the head and body are 5 ft. 9 ins.

10. *Coimbatore.*—A flat skin of an old tiger, presented by Mrs. Cozens, is very pale, the white everywhere blending with the pale tawny hue of the ground colour, but the pallid hue is probably due to exposure to light, the skin having been made into a rug. The coat is very short and smooth, and the stripes are thin and not nearly so black as in most Indian tigers owing to the hairs being pale at the base. The skin measures 10 ft. 2 ins. ; but the label indicates that in the flesh the animal was only 9 ft. 4 ins., small, that is to say, for an Indian tiger.

11. *Madras.*—The flat skin of a tiger presented by Col. Sykes resembles the less handsome of the two Chota Nagpur skins in coat, colour and narrowness of the stripes, but the stripes are more numerous ; the hair on the cheek and throat is much longer than in the other skins described, and there is a distinct mat-like mane, 2 ins. or more in length, extending over the nape from the occiput. The skull shows that this skin was that of an adult animal, but the head and body measure only 5 ft. 6 ins., the tail being absent.

12. *Coorg.*—The skin of a tigress, shot by Mr. G. C. Shortridge is the only representative of the species that reached the British Museum from the Survey. It is a richer and darker tinted skin than those from Chota Nagpur but hardly darker than the one from Bengal. All the stripes are deep black and well defined, broad, normally spaced and some of them looped. The coat is longish and rough. It measures 8 ft. 9 ins., but since the tail and head are very much stretched from being pegged out to dry, the tigress was evidently quite a small animal. But there is no skull by which her age can be determined.

Skulls of Indian Tigers

(Pls. B a; C a-d.)

To make clear the terminology used in the tables of skull-measurements in this paper it may be explained that the dimensions have been taken with callipers and dividers as follows:—

Total length from the edge of the occipital crest to the tip of the premaxillæ above the incisor teeth.

Condylo-basal length (*Cond. bas.*) from the posterior edge of the occipital condyle to the tip of the premaxillæ. This is a more satisfactory measurement than the first because it is independent of the development of a muscular ridge.

Zygomatic width (*Zygom.*) across the cheek-bones.

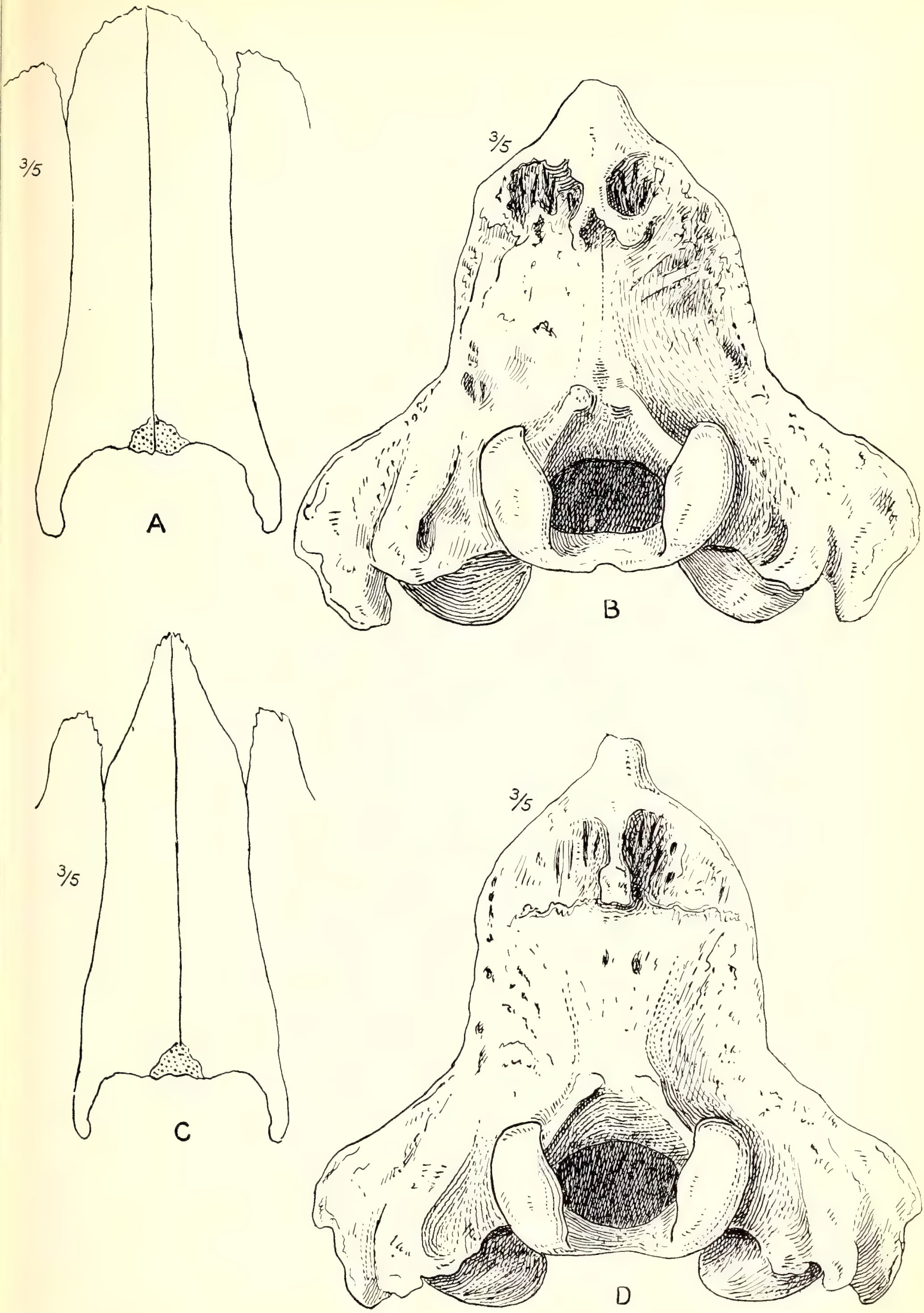
Nasals; the length is taken from the middle line on the forehead to the tip of the process bounding the nostrils laterally above, and the width across the nostrils from process to process outside.

Occiput; the width is taken as nearly as possible at the points where the vertical sides pass outwards into the lateral processes ending in the mastoids behind the orifice of the ear; the height of the occiput varies with the development of the median crest at its summit.

Teeth; these are measured in millimetres, not in inches, the upper flesh-tooth (*Upper carn.*) along its outside edge, and the lower flesh tooth (*Lower carn.*) from front to back, both being subject to small variations with wear. The *Canine* is measured from front to back close to the socket.

In the last edition of *Rowland Ward's Records*, 1928, pp. 480–481, the dimensions of a large number of skulls of Indian tigers are given. They vary from about 13½ inches to just under 16 inches, the largest marked —16 having been obtained by Mr. B. B. Osmaston in Naini Tal. Roughly, 50 per cent of them are between 14 and 15 inches and about 25 per cent between 15 and 16 inches and 13½ and 14 inches respectively. They appear to be the skulls of males, and their average length may be put at 14½ inches. It may be noted that they range in distribution from the Himalayas to the Central and United Provinces, there being only one record from Southern India, namely, from Kanara.

In the following Table I give the dimensions of some skulls of Indian tigers in the British Museum; but here again there are only two complete skulls from Southern India available, namely, from Kanara and Madras. The skulls have been arranged in the list, not by size but by locality.



A. Nasals and summit of maxillæ of Tiger from Darjiling.
B. Posterior view of occiput of the same.
C,D. The same bones of a Tiger from the Nepal Terai.

	English Inches					Millimetres.		
Loc. and Sex.	Total length.	Cond. bas. length.	Zygom. Width.	Nasals.	Occiput.	Upper carn.	Lower carn.	Base of canine.
Darjiling ♂ ...	15	$13\frac{1}{5}$	$10\frac{2}{5}$	$5 \times 2\frac{4}{5}$	$3\frac{2}{5}$	37	30	29
Khatmandu ♂ ...	...	...	$9\frac{3}{10}$	$4\frac{7}{10} \times 2\frac{1}{2}$	...	37	29	27
Nepal ♂ ...	14	$12\frac{1}{10}$	$9\frac{1}{2}$	$5 \times 2\frac{3}{10}$	$2\frac{9}{10}$	36	...	28
Nepal ♂ ...	$13\frac{4}{5}$	12	$9\frac{2}{5}$	$4\frac{4}{5} \times 2\frac{1}{10}$	$3\frac{1}{10}$	38	28	26
Nepal ♂ ...	$13\frac{4}{5}$	$12\frac{1}{5}$	$9\frac{1}{2}$	$4\frac{4}{5} \times 2\frac{2}{5}$	$3\frac{1}{5}$	37	27	29
Nepal Terai ♂ ...	$14\frac{3}{10}$	$12\frac{2}{5}$	$10\frac{1}{5}$	$5 \times 2\frac{1}{2}$	$2\frac{4}{5}$	...	29	29
Bhutan Terai ♂ ...	$14\frac{3}{10}$	$12\frac{4}{5}$	$9\frac{3}{5}$	$5 \times 2\frac{2}{5}$	$3\frac{2}{5}$	35	27	28
Bengal ♂ ...	$14\frac{9}{10}$	$13\frac{1}{10}$	$10\frac{1}{5}$	$5\frac{2}{5} \times 2\frac{1}{2}$	$3\frac{1}{5}$	37	27	30
C. Prov. ♂ ...	$14\frac{1}{5}$	$12\frac{2}{5}$	$10\frac{4}{5}$	$5 \times 2\frac{3}{5}$	$2\frac{4}{5}$	36	26	28
C. Prov. ♂ ...	$13\frac{1}{10}$	$11\frac{7}{10}$	$9\frac{9}{10}$	$4\frac{1}{2} \times 2\frac{4}{5}$	3	35	25	26
Kanara ♂ ...	$12\frac{4}{5}$	...	9	$4\frac{1}{10} \times 2\frac{1}{5}$	$2\frac{7}{10}$	36	26	26
Madras ♂ ...	$12\frac{1}{2}$	$11\frac{3}{10}$	$8\frac{4}{5}$	$4\frac{2}{5} \times 2\frac{1}{10}$	$2\frac{4}{5}$	34	26	25
Nepal ♀ ...	$12\frac{3}{10}$	$10\frac{9}{10}$	$7\frac{4}{5}$	$4\frac{1}{10} \times 2$	$2\frac{1}{2}$	35	26	23
Nepal ♀ ...	$12\frac{1}{5}$	$10\frac{7}{10}$	$7\frac{4}{5}$	$4\frac{2}{5} \times 2$	$2\frac{3}{5}$	33	24	21
Nepal Terai ♀ ...	$11\frac{4}{5}$	$10\frac{2}{5}$	$7\frac{7}{10}$	$4\frac{1}{10} \times 2\frac{1}{10}$	$2\frac{3}{5}$	35	26	23
Muttra ♀ ...	$11\frac{2}{5}$	$10\frac{1}{5}$	$7\frac{3}{5}$	$3\frac{9}{10} \times 1\frac{9}{10}$	$2\frac{4}{5}$	31	22	20
Mirzapur ♀ ...	$11\frac{9}{10}$	$10\frac{3}{10}$	$7\frac{4}{5}$	$4\frac{1}{5} \times 1\frac{9}{10}$	$2\frac{1}{2}$	33	24	23
Chota Nagpur ♀ ...	$11\frac{3}{5}$	$10\frac{1}{5}$	8	$4 \times 2\frac{1}{10}$	$2\frac{7}{10}$	32	...	21
Chota Nagpur ♀ ...	$11\frac{2}{5}$	$10\frac{3}{10}$	$7\frac{9}{10}$	$3\frac{9}{10} \times 2$	$2\frac{3}{5}$	32	25	20

In addition to these skulls there are several others in the British Museum; but since they are merely ticketed India and show no special features, their measurements have not been included; and all immature skulls have been omitted.

The average length of male skulls is about 14 inches and of the females about 12 inches. Female skulls are also relatively lighter and less muscularly developed, and the occipital condyles touch, or nearly touch, a flat surface when the skull rests upon it; also the carnassial teeth are a little smaller and the canine markedly thinner at the base and shorter; but I have not recorded the length of the canine in either sex because it varies with age and wear. In most cases no sex mark is indicated on the labels; but by the use of the above-mentioned data, any normal tiger's skull can, I believe be sexed correctly. The skull, for instance, from Kanara, which was presented by R. C. Wroughton, although labelled ♀ I have no hesitation in regarding as a ♂. The label is not in Wroughton's handwriting; and I know nothing further of the history of the specimen, but Mr. T. B. Fry, who knew Wroughton well, tells me he does not think he ever shot a tigress in Kanara. The skull from Madras (Col. Sykes) I also sexed by the characters mentioned.

The interesting point about these two skulls is that their average dimensions are considerably below those of the male skulls from northern and Central India, intergrading between them and the tigresses' skulls from those districts. They confirm, indeed, the opinion generally held, I believe, by Indian sportsmen, and expressed by Dunbar Brander, that the tigers of South India are smaller than those of North and Central India. On the other hand, a skull from Kanara in Rowland Ward's Records for 1928 measures 14¼ inches and is about as large as most northern tigers' skulls; but of course intergradation occurs. Also the jaws taken from the tiger's skin from Coimbatore, referred to above, are more massive than those of the British Museum skulls from Kanara and Madras, indicating a larger beast; but the skin in question measured only nine feet four inches in the flesh, which is decidedly small for a northern tiger.

There is one other skull to which I must refer in this connection, namely, that recorded by Mr. Prater as a record panther skull (*Journ.*, *Bombay Nat. Hist. Soc.*, vol. xxvii, p. 933, 1921). The animal was shot in the dusk near Ootacamund by Mr. Limouzin[1] who thought it was a panther and subsequently found in the jungle its presumed remains eaten by jackals, with none of the pattern of the skin remaining. Struck by the size of the skull, he sent it to the Bombay Natural History Society where it was determined by Mr. Prater as certainly a panther's, and a good record at that, the *basal length* being $11\frac{3}{10}$ inches, the leopard's skull, which at that date headed Rowland Ward's list, being a skull from the Gaboon, owned by Sir Edmund Loder, which I described and measured in 1909. This skull had a *total length* of 11⅛ inches and a *basal length* of only 9 inches,[2] that is to say 2½ inches shorter than Mr. Limouzin's specimen. There is no doubt that the latter was the skull of a tiger or tigress, probably a tiger since its basal length is exactly the same as that of Col. Sykes' Madras specimen. True it is nearly ½ an inch narrower across the zygomata, but that discrepancy is of no great moment, as may be seen by comparing the lengths and breadths of the skull from Bengal and of the one from the Central Provinces that comes next to it in my table. Fortunately Mr. Prater published a photograph of the skull of Mr. Limouzin's specimen alongside those of an Indian leopard, tiger and lion.[1] From this it may be seen that the jaws and canine tooth of the first, the alleged record panther, are much larger than those of the leopard. Mr. Prater, moreover, records the weight of the skull as 2¼ lbs., which is ½ a lb. heavier than the heaviest leopards' skulls, all African, in Rowland Ward's list. In this list of leopards Mr. Limouzin's tiger takes fourth place for size—it is really, on the data given, entitled to the third place—but it should stand easily first, because its total length was no doubt nearly 13 inches. Apart, however, from the errors to which the records of this skull have given rise, it is an exceedingly interesting thing that the skull of a South Indian tiger, if adult, should be so small as to be mistaken for a panther's.

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[1] (*Vide* note on page 699 of this Number—EDS.)

[2] I have italicized these measurement because, although this leopard's skull from the Gaboon was correctly entered in Rowland Ward's Records 1914 as measuring 11⅛ inches in *total* length, in the 1928 edition that figure is stated to be its *basal* length, which is quite wrong. According, indeed, to the table printed in that edition (p. 485), four of the leopards' skulls are longer than any Indian tigress's skull I have measured and as long as several of the tigers' skulls.

The history of the specimens mentioned in my list, setting aside the two from Kanara and Madras, is as follows :—The skulls from Nepal came from Hodgson's and Hardwicke's collections ; those from the Nepal Terai were shot by King Edward VII, when Prince of Wales ; those from Bengal and Mirzapur were secured by Colonel Sanderson ; from Darjiling by E. le F. Davys ; from Khatmandu by H. A. Oldfield ; from the Bhutan Terai, north of Kangrabai, by M. Maxwell ; the smaller of the two from the Central Provinces was presented by F. W. Withers and the larger came from Mawlla and was presented by B. B. Osmaston. This skull is wider across the zygomatic arches than any in my list or Rowland Ward's list ; and since a tiger shot by Mr. Osmaston at Naini Tal heads Ward's list with a length of 16—, Mr. Osmaston holds the records for length and width. The two tigress's skulls from Chota Nagpur (Palamau) were taken from rugs presented by Capt. S. N. Walker.

The tigers from Assam, Burma and the Malay Peninsula of which I have seen no skins and only a few skulls, are briefly dealt with in a later part of this paper. They are provisionally referred to the same race as the Indian tiger, *Panthera tigris tigris.*

THE TIGERS OF THE CASPIAN AREA

The name and synonomy of these tigers, known to the ancients as the Hirkan Tiger, are as follows :—

Panthera tigris septentrionalis, Satunin.

Felis virgata, (ex Illiger) Matschie, *Sitz. Ber. Ges. Nat. Fr. Berlin* 1897, p. 13 (name preoccupied by *Felis virgata* given to the Norwegian lynx by Nilsson in 1829).

Felis (*Tigris*) *tigris septentrionalis*, Satunin, *Zeitschr.* '*Priroda iochota*', vii, p. 5, 1904.

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[1] In confirmation of his opinion that the skull under debate was a panther's, Mr. Prater draws attention to the height of the tiger's occipital condyles above the surface of the table on which it rests, whereas in the other three skulls they rest upon it. But in many skulls of tigers the condyles similarly rest on a horizontal plane.

Tigris septentrionalis, Satunin, *Mitth. Kauk. Mus.* ii, p. 308, pl. iv (skull), 1905–1906; *id.*, *op. cit.* iv, p. 33, 1909; *id. Conspect. Mamm. Imp. Ross.* p. 156, 1914 (printed in Russian).

Tigers were procured near Lenkoran in Talish on the coast of the Caspian, to the south of the Caucasus, by Radde in 1866 and were identified as *Felis tigris*. But in 1897 a specimen, exported from Tiflis and exhibited in the Berlin Zoological Gardens, was seen by Matschie who, considering it to represent a race distinct from the typical tiger, called it *Felis virgata*. An enlarged photograph of this tiger was published by Dr. Heck (*Lebende Bilder*, p. 157, 1899), a volume containing photographs of a number of interesting mammals living in the Berlin Gardens at the time. The name adopted by Matschie for this animal was, however, inadmissible for the reason stated in the above-quoted synonymy. Subsequently, in 1904, Satunin, in ignorance of Matschie's paper, gave the name *septentrionalis* to a Transcaucasian tiger preserved in the Tiflis Museum of which he was Curator; and this was followed two years later by a long and complete description in German. He discussed the animal again in 1909, justifying the adoption of the name *septentrionalis* because of the preoccupation of *virgata* and because he thought it very possible that the Lenkoran example might turn out to be a different race of tiger from the one seen by Matschie, for which no precise locality was known. Since this view appears to me to be very improbable, I follow Lydekker's opinion that *virgata* and *septentrionalis* were applied to the same local race.

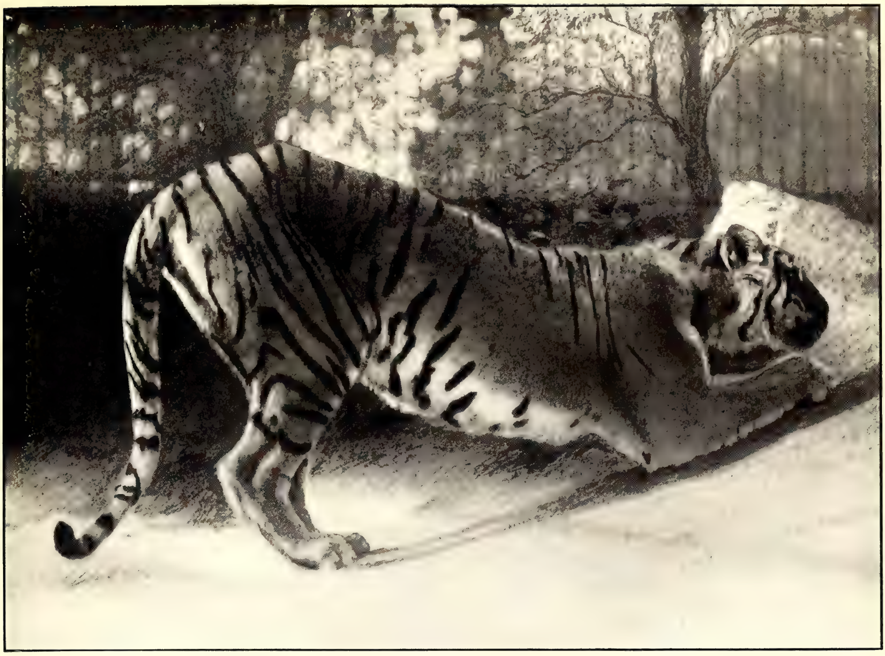
There is little, if any, difference in size between this tiger and the typical race from India; but the ground colour is a somewhat richer, darker red with the stripes more numerous, closer set and showing a tendency, at least in some specimens, to turn brown; the coat even in the summer appears to be thicker and in the winter the fringes on the sides of the face and along the belly are very long, as is clearly shown in Heck's figure of the example described by Matschie. (Pl. D. lower fig.)

Satunin laid special stress on the colour of the stripes in distinguishing this race from the typical Indian tiger. He said:—' In all the Transcaspian and Lenkoran tigers seen by me the stripes on the shoulders, the hinder part of the neck and especially on the outer side of the thigh are not only not black but even pale brown.'

From this, and other points of view, the specimens in the British Museum which I refer to this race are extremely interesting in the great variation they exhibit, two having the stripes as black to all intents and purposes as Indian tigers, one having them partly brown and the other wholly brown.

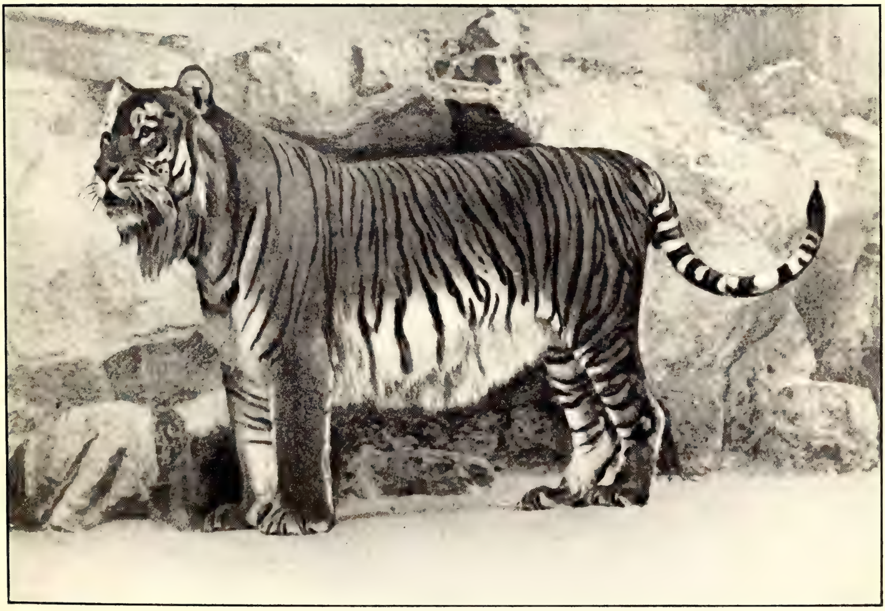
These skins may be described briefly in the order named:—

1. An old tigress in perfect coat obtained in 1886 by Dr. Aitchison, of the Afghan Boundary Commission, on the Bala Murghab river to the north of Herat and identified as *Felis tigris*. The ground colour is rich tinted, rather darker and with the white areas more strongly defined than in any Indian tigers I have seen. The stripes are narrow, more numerous and closer set, quite black all down the spinal area, on the flanks and belly but faint on the



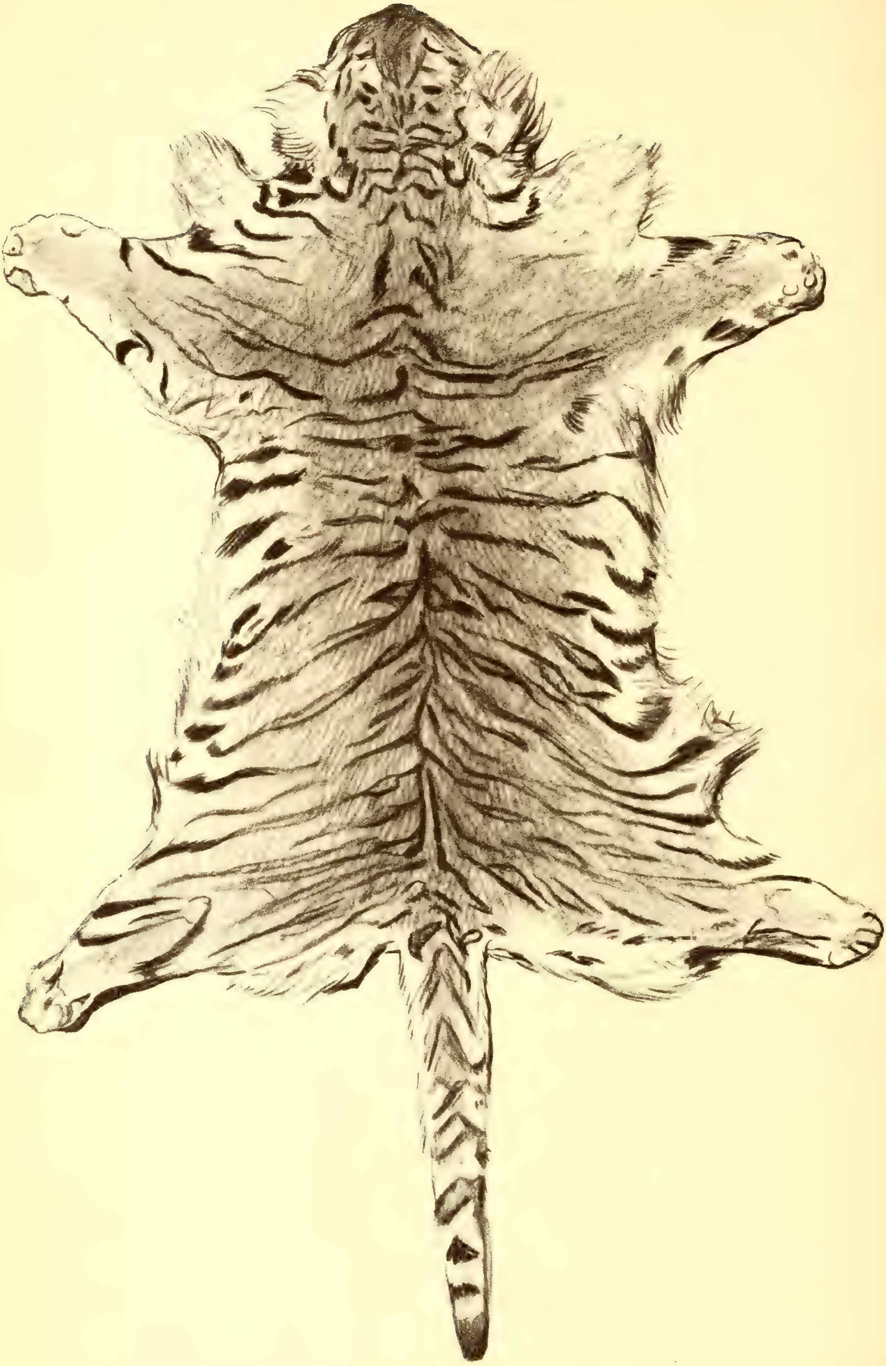
[*Photo W. S. Berridge*].

Tigress, from Nepal, showing unusual reduction in the stripes.



[*Reproduced by the kind permission of Dr. Heck*].

Tiger, from the Caucasus, in the Berlin Gardens.



SKIN OF AFGHAN TIGER.

fore part of the shoulder, and on the thighs and outer side of the hind leg indistinct and brown. It is noticeable that the upper ends of the stripes on the croup unite on each side to form a longitudinal stripe separated from its fellow by a median pale area. The coat is longish, thick and soft, much longer than in any Indian skin in the Museum. The stripes, however, in Indian skins generally, if not always, show a tendency to brownness at least low down on the thighs. (Pl. III.)

2. A mounted tigress obtained at Astrabad in N. Persia by Col. Beresford Lovett and presented to the British Museum in 1882. As in the Afghan specimen, the stripes are as black as in typical Indian tigers and are numerous and close-set, but the fusion of the croup stripes is not so emphatic. This tigress and the Afghan specimen apparently agree very closely in pattern with the photograph of the skin of the specimen shot by Col. R.L. Kennion in Mazanderan forest in Northern Persia.

3. A mounted male specimen labelled Persia and presented by Messrs. Rowland Ward. This also is a rich tinted specimen with numerous narrow stripes. On the top of the head and down the back the stripes are black, but they fade to brown on the flanks, and on the outside of the thighs they are only a little darker than the ground colour; they are also brown on the base of the tail and even on the belly and chest. The tendency toward the longitudinal fusion of the stripes on the croup is also noticeable. The white spot over the eye is smaller than in Indian tigers, and this appears to be a general feature in this race; but this specimen exhibits the peculiarity of having the spot on the back of the ear tan instead of white. This tiger resembles the specimens mentioned by Satunin in the brown tint of the stripes; but the brown is more extensive.

4. The dressed skin of a tigress ticketed 'Northern slopes of Mount Elburz[1]' and presented by Col. R. L. Kennion who told me it was presented to him by a native chief. This tiger, represented in the coloured plate, is of extreme interest. The ground colour and the pattern are as in the Afghan specimen; but there is not a trace of black on the skin, all the stripes being brown and indistinctly defined owing to their approximation to the general hue of the coat. It is possible, of course, that this skin may represent a red variety, comparable to a red cat and coming into the same class as the black and white aberrations of the tiger above described. On the other hand it must be noted that the complete suppression of the black pigment in the stripes is merely an extension of the process observable to a lesser degree in the mounted male specimen described above. The available material, indeed, of this race seen by me and recorded by Satunin seems to show a nearly complete gradation between the black stripes typical of tigers in general and the reddish brown stripes of the Mount Elburz example. (Pl. I coloured.)

In the report upon the animals he collected as naturalist to the Afghan Boundary Commission, Dr. Aitchison (*Tr. Linn. Soc.*

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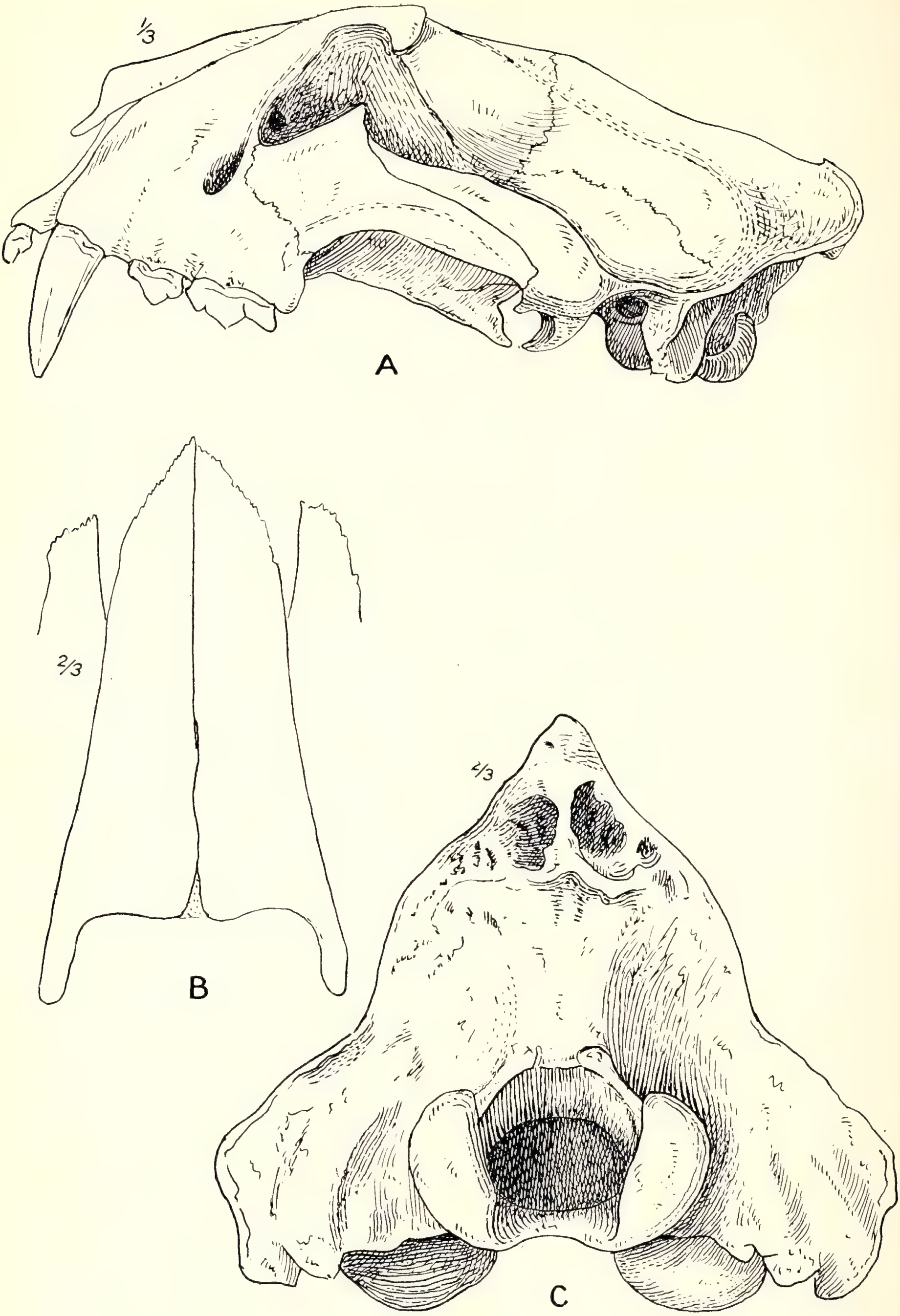
[1] *Note:*—On Pl. I representing this tiger, the locality was by error given as Caucusus. The error has been corrected to 'Elburz'.

Lond., *Zool.*, vol. v, p. 56, 1888) states that the tigress above described was killed at Karaol Khana on the Bala Murghab river, which lies to the north of Herat, and brought into camp. She measured in the flesh 8 ft. 4¾ inches, and, as indicated by her worn teeth, was evidently old. Tracks of tigers were also seen in the valley of the Hari-rud and at the Chasma Salz pass at 5,000 ft. The tigers wander over the great rolling plains of the Badghis, ascending to higher altitudes in the summer and preying upon pig, oorial and even ibex. Although taken from an old animal, the skin is in perfect condition with regard to coat and colour and has scarcely been stretched by being dressed.

I can find no published particulars regarding the tiger, killed by Major C. E. Yate near Pindjeh, the skull of which is in the British Museum. It is not mentioned either in his book or in the report upon the collection he sent to Calcutta (*Journ. As. Soc. Bengal*, vol. 56, p. 68, 1887).

Col. R. L. Kennion gave an account of the shooting of the tiger he secured in Mazanderan forest in Northern Persia (*By Mountain, Lake and Plain. Sport in Eastern Persia*, p. 244, 1911). He described it as big as a good Indian tiger, the skin when pegged out measuring 11 ft. 6 ins., from which it may be inferred that the animal in the flesh measured 10 ft. 6 ins. or less. The coat, he adds, was of course nothing like that of a winter Siberian tiger but was perhaps a little longer than that of an Indian 'Christmas' tiger. Col. Kennion only came across two examples of this tiger; and there is reason to fear that the race is on the wane. Satunin, for example, records that when Radde made his first expedition to Transcaucasia in 1866, tigers were fairly plentiful; but were much scarcer in 1879–1880 when he visited the country again.

Records of the size of this tiger are few and unsatisfactory. The two stuffed specimens from Lenkoran in the Tiflis Museum measure as mounted, according to Satunin, about 9½ ft. and 8½ ft. respectively. They are probably tigresses. The dressed skin of Col. Kennion's red tigress from Mount Elburz is about 8 ft. 2 ins., and Dr. Aitchison's tigress from the Afghan boundary was 8½ ft. in the flesh. This is the only reliable record. The newly stripped skin of the tiger shot by Col. Kennion in the Mazanderan forest measured, when pegged out, 11½ ft. When dressed, the skin was reduced by Rowland Ward to 10 ft. 8 ins., which was probably about the natural length of the beast. From these imperfect data it may be inferred that this race of tigers is not larger, possibly it is on the average somewhat smaller than the typical Indian race. But I must not suppress a surprising record published by Satunin, who states that he saw in the flesh a Transcaspian tiger of 'colossal dimensions' . . . 'hardly smaller than an ordinary native horse.' Its stripped skin from the tip of the nose to the *root* of the tail (italics mine) was 3½ metres—that is to say about 11½ feet. This would have meant a total length of about 14½ feet! I must leave it at that, with the comment that the learned Russian was not a sportsman 'out' for records.



A. Skull of Tiger (*Panthera tigris septentrionalis*) from Maruchak, near Pinjdeh, on the Russo-Afghan frontier.

B. Nasals and summit of maxillæ of the same.

C. Posterior view of occiput of the same.

The following are the measurements and particulars of the skulls :—

	English Inches.					Millimetres.		
Loc. and Sex.	Total length.	Cond. bas. length.	Zygom. width.	Nasals.	Occiput.	Upper carn.	Lower carn.	Base of canine.
Lenkoran ♂	$14\frac{2}{5}$	...	...	...	...	...	...	...
Mazanderan ♂	$13\frac{1}{2}$	...	10	...	...	...	...	...
Pindjeh ♂	$13\frac{1}{3}$	$11\frac{4}{5}$	$9\frac{1}{10}$	$4\frac{1}{2} \times 2\frac{4}{5}$	$3\frac{1}{10}$	37	25	26
Karaol Khana ♀	$11\frac{1}{3}$	10	8	$3\frac{9}{10} \times 2\frac{1}{5}$	$2\frac{4}{5}$	32	21	19
Astrabad ♀	...	10	$7\frac{1}{3}$	$3\frac{4}{5} \times 2\frac{1}{10}$	$2\frac{3}{5}$	32	21	21
Mt. Elburz ♀	...	...	...	$3\frac{3}{5} \times 1\frac{9}{10}$	...	...	20	21

These measurements confirm the conclusion to be drawn from the skins that the Transcaspian tiger is about the size of an average Indian tiger ; but the skull of the adult male from Pindjeh certainly differs from the skulls of typical Indian tigers in the shape of the dorsal profile. From the hinder edge of the postorbital processes, which is more elevated than in ordinary tigers, the forehead and nose slope tolerably evenly downwards and forwards to the end of nasals above the nostrils and behind the processes the upper edge of the skull slopes downwards and backwards at nearly the same angle of inclination to the occipital crest. The edge, however, is markedly sinuous but is much less concave than in typical Indian tigers owing to the elevation of the longitudinal crest which rises like a keel from the frontals a little behind the postorbital processes. In Indian tigers this crest is always lower over the frontals and parietals but increases somewhat rapidly in height towards the occiput, giving the characteristic concave curvature to the upper edge of the brain case. The differences above described may be seen by a comparison between my figure of the skull of the tiger from the Afghan Frontier and that of the one from the Central Provinces of India. For the rest it may be added that in the Afghan Frontier skull the occiput is remarkably broad and unconstricted and that the nasals are shorter as compared with their width than in Indian tigers. (Pl. E.)

So far as I can judge from the photograph published by Satunin, the skull of a tiger from Talisch agrees very closely in shape with the one from the Afghan Frontier described above except that the upper edge of the median cranial crest is straighter ; but in the skulls of the two tigresses from the Afghan Frontier and Astrabad respectively the forehead is much more rounded resembling the forehead of Indian tigresses.

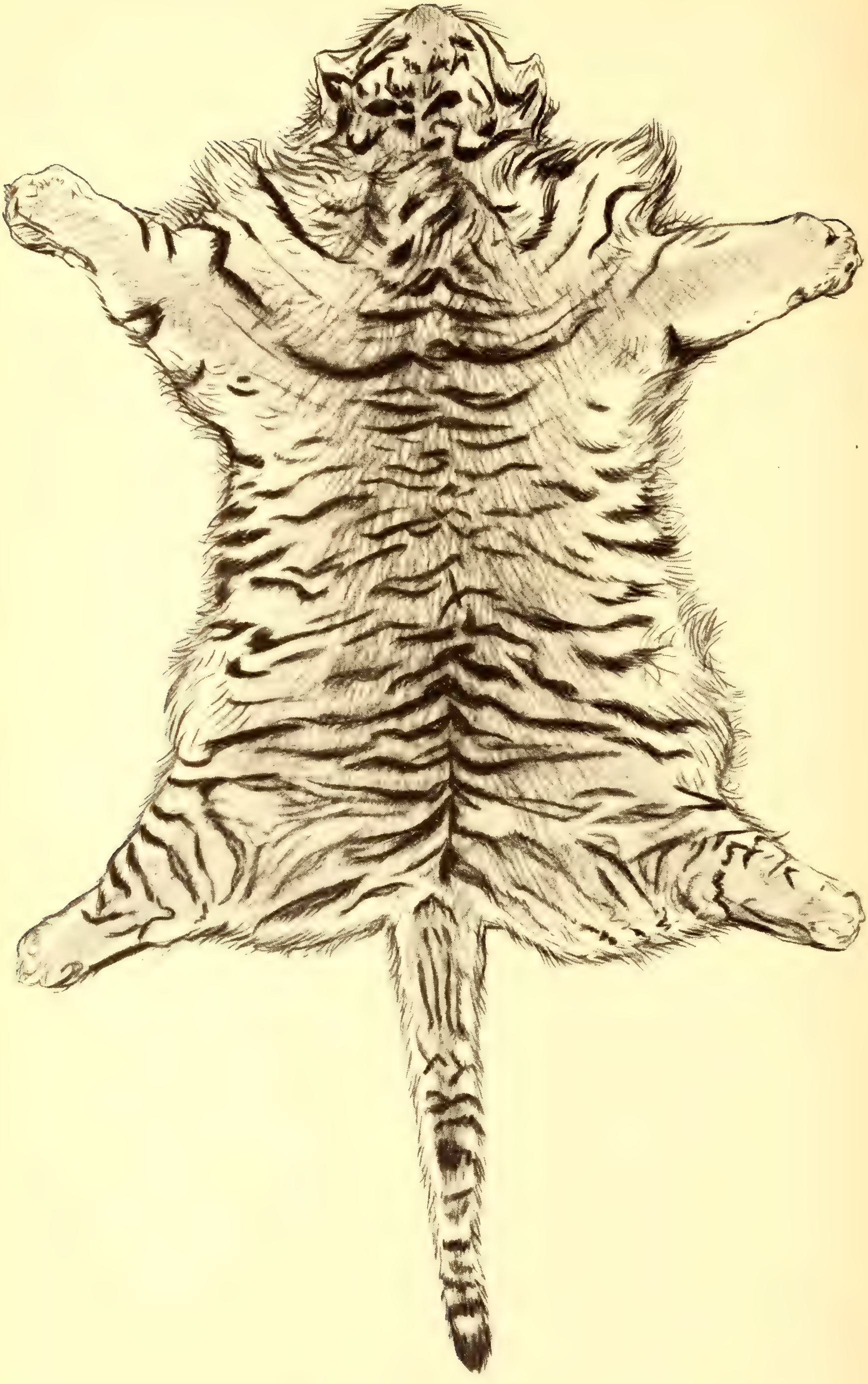
It is a curious and interesting fact that of all the tigers' skulls in the British Museum the one most like the male skull from the Afghan boundary is the male skull from Sungei Kumbang in Sumatra recorded below, although the latter has wider, shorter nasals and the lower cranial crest. The resemblance is all the more puzzling because the two races of tiger, so widely sundered geographically, are also much alike in the number and closeness of their stripes and the length of the fringe on the cheeks.

THE TIGERS OF MONGOLIA, MANCHURIA AND NORTH CHINA

In the account of the tigers of the Transcaspian area it was shown that they extend from the south-eastern slopes of the Caucasus to the Afghan boundary. From this district the species was formerly at all events continuously distributed in a north-easterly direction through Turkestan, Bokhara, the Altai and Mongolia as far as the Stanovoi mountains to the north of Manchuria. Records of their occurrence in these countries were incorporated by J. B. Brandt in his treatise on the geographical distribution of the species, published in 1859 (*Mem. Akad. Imp. St. Petersburgh Sci. Nat.*, vol. viii, pp. 144–239). From Manchuria they pass southwards into Corea and at least through the eastern and central parts of China ; but they were not encountered by the American zoological expedition through Shansi, Shensi and Kansu to the south of the Ordos desert in Mongolia (Clark and Sowerby, *Through Shen-Kan*, 1912). In southern China they are apparently plentiful and their occurrence as far to the west as Szechuen is attested by the skull of an immature male from that district in the British Museum.

Owing unfortunately to the need of properly localized material, our knowledge of the tigers of Central Asia, China and the areas to the north of that country, where they occur, is very defective ; and accounts of them are in some cases bafflingly discrepant. For instance, Swinhoe (*Proc. Zool. Soc.*, 1864, p. 378) recorded a skin from Newchwang (Niu-chwang), south of Mukden, in the northernmost part of China, as pale coloured and scantily striped. Milne Edwardes, on the other hand, had one from North China which differed, he declared, from the skins of Indian, Cochin Chinese and Javan tigers in having a longer and thicker coat and in being darker (*plus brune*) on the back (*Rech. Mamm.* i, p. 207, 1874). This author also quoted an item of information received from l'Abbé David to the effect that in Manchuria the tint of tigers varies from brownish black to white. Dode (*Proc. Zool. Soc.*, 1871, p. 480) described a skin from Amurland as having longer hair, less pronounced stripes and paler colour than Indian tigers ; whereas D. G. Elliot (*Monograph of the Felidæ*, 1883) figured a tiger from one of Dode's alleged Amurland skins, showing it to be not only darker but exceptionally heavily striped.

Korean tiger skins, imported into Japan, Temminck (*Fauna Japonica*, p. 28) long ago described as longer haired and paler



SKIN OF MANCHURIAN TIGER.

coloured than Indian tigers; but Dunbar Brander wrote of Korean tigers as follows:—'In Korea such specimens as I saw, compared with the Indian beast, were higher on the leg, had a tendency to have withers, the neck appeared short and did not flow on from the shoulders as in the case of the Indian animal. In size and weight, however, they were inferior to Indian tigers. As I only saw a few specimens, I cannot say if these characters are general; but the Korean animal is essentially different from what one understands by a Manchurian tiger.' (*Wild Animals in Central India*, p. 46, 1923). His conception of Manchurian tigers was expressed in a previous passage in which he classed them with the Siberian and Amurland tigers as 'immense hairy animals, much larger than anything now found in India'. But it does not appear that he was here speaking of Manchurian tigers from his own knowledge in the field. Probably he knew them from imported skins, from general hearsay and from Rowland Ward's Records.

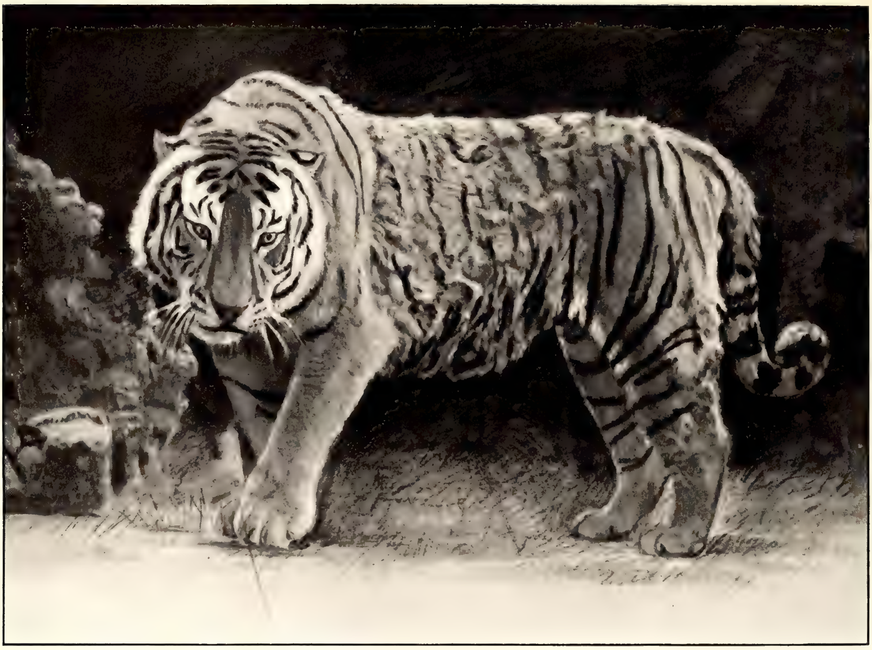
However that may be, it is significant that Dode's, Swinhoe's and Temminck's descriptions of skins from Amurland, Niuchwang and Korea respectively are in complete agreement, so far as they go, and point to the occurrence in those parts of Asia of a tiger which is paler coloured, less richly striped and thicker coated than the typical Indian animal. This conclusion is borne out by a skin which Mr. Swinhoe (*Proc. Zool. Soc.*, 1870, pp. 3–4) subsequently brought from Manchuria and sold to the British Museum, where it is still preserved. (Pl. IV). The coat is much longer and thicker than in any of the Indian skins in the collection, and is also paler in tint than all but those apparently faded by exposure to light as rugs, e.g. the skin from Coimbatore referred to above; and it is markedly paler than the skins from Mount Elburz and the Afghan boundary and is also thicker in the coat. There is a distinct mane about 2 in. long. It cannot be described as a well-striped skin as compared, for example, with Col. Sanderson's Bengal example. The stripes are thicker and stronger on the hinder part of the body and croup than in the middle of the body behind the shoulders where they are narrower, shorter and more spaced. They are not markedly looped and they are blacker on the middle line than laterally. On the flanks they show a tendency to brownness, and this is still more evident on the outside of the shoulder and thighs; on the thighs they are so brown as to be quite obscurely defined. The skin is that of a male and I make its measurements as follows:—Head and body 90 ins., tail 42 ins., giving a total of 11 ft. If the tiger was that length in the flesh, he was a big beast; but the deduction of a foot or ten inches for stretching would bring him to about the size of an Indian tiger. Dressed skins, however, do not always stretch.

Very similar to Swinhoe's Manchurian skin is a stuffed male specimen in the British Museum purchased from Rowland Ward and labelled Manchuria but entered in the register as Mongolia. It stands alongside a tiger from the Central Provinces and is certainly not a bigger animal. It is curious for the absence of the stripes on the flanks behind the shoulder. In this particular as in having a whiter tail and the base of the tail more normally striped, this tiger differs from Swinhoe's skin, but it can hardly be doubted that the two represent the same race of tiger. Whether this tiger came from Mongolia or Manchuria I do not know. Indeed, it appears that all the thick-coated tigers of Northern Asia are indiscriminately cited as Manchurian, Mongolian or Siberian without regard to the fact that Manchuria and Mongolia are different countries and may possibly have different races of tigers.

I also refer to the Manchurian race a pair of tigers presented by the Duke of Bedford in 1906 to the Zoological Gardens where they lived about ten years. My reason for thinking they probably came from Manchuria or from the coastal strip of Siberia or northern Korea, which separate Manchuria from the sea, is that Vladivostock was their port of shipment. The male of this pair, shown in one of the photographs illustrating this paper, naturally appeared in his winter coat to be a considerably more robust animal than the perennially short, smooth-coated Indian tigers. (Pl. F, upper fig.) He was also somewhat larger, standing 38 ins. at the shoulder as opposed to 36 ins. which is about the stature of a good Indian tiger. The seasonal changes in colour and thickness of the coat in these tigers were interesting. The new, short summer coat, donned by July, was rich in tint, hardly at all paler than the coat of typical Indian tigers; but in mid-winter, when the coat was long and thick, it was paler, with the stripes less sharply defined; and as the time for the moult in early summer approached, the hair had a dull, pallid lifeless look. Now our knowledge of these Manchurian tigers is derived mainly from traded skins stripped from beasts shot or trapped in winter; and that accounts for the invariable description of them as thicker coated and paler than Indian tigers.

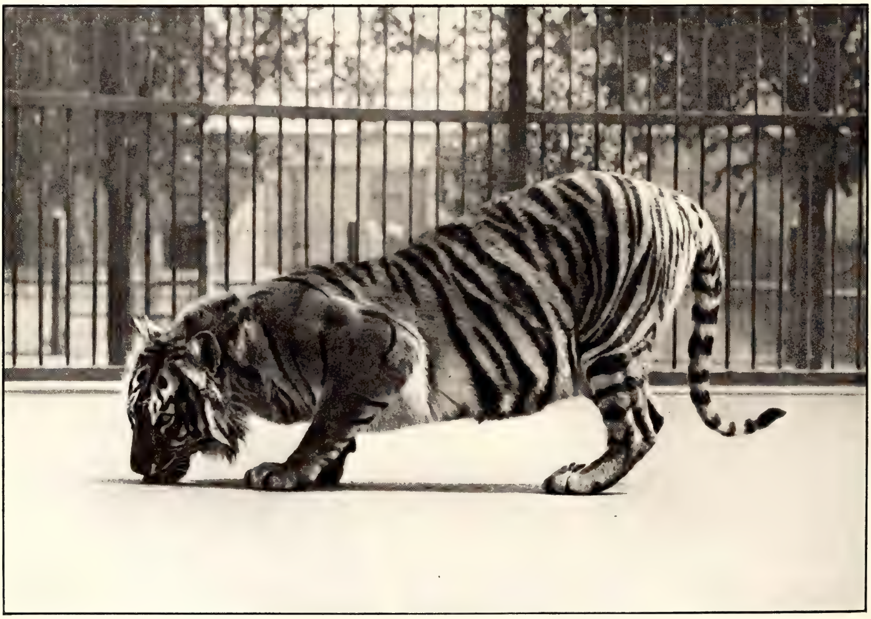
I am greatly indebted to the Duke of Bedford for the opportunity to examine the skin of the tigress, shipped from Vladivostock, which was sent to him at the animal's death in the Zoological Gardens. She died on December 30, in full winter coat. The skin is noticeably paler in tint than Swinhoe's Manchurian skin and the coat, although thick and woolly, is shorter and closer; and, perhaps on that account, the stripes are more sharply defined; but they are longer over the shoulder and not so brown on the flanks and thighs; only a few form short, narrow loops. There is a short mane. The face is whiter, with a very faint wash of buff on the cheek; and everywhere the white blends with the coloured areas; in the middle of the skin the combined marginal white areas of the belly are less in width than the tinted area of the flanks and back between them, but the coloured area of the legs is narrow, hardly wider than in the photograph in Rowland Ward's Records referred to below. I make the head and body 74 ins., the tail 34 ins., giving a total of 9 ft., no larger, that is to say, than a North Indian tigress.

No skull of this tiger is available for examination, and none appears to have passed through Rowland Ward's hands; but according to accounts, the skulls of northern tigers in general do not differ in any points of importance from those of Indian tigers. This was the verdict of Busk (*Proc. Zool. Soc.* 1874, p. 147), who examined and measured the skull of a male brought by



[*Photo by F. W. Bond*].

Manchurian Tiger, in the London Zoological Gardens, moulting his winter coat.



[*Photo F. W. Bond*].

Tiger, in the London Zoological Gardens, from the Malay Peninsula.

Swinhoe from Kirin in Manchuria. The measurements he gave are as follows :—

	English Inches.				Millimetres.		
Loc. and Sex.	Total length.	Cond. bas. length.	Zygom. width.	Nasals.	Upper carn.	Lower carn.	Canine
Kirin ♂ ...	13½	12 +	8⅘	4⅕ × 2⅕	36	26	27½

This skull was a little smaller than average sized skulls of north Indian tigers recorded in my list. It was also a little smaller than the skulls of two Indian tigers and of one brought by Swinhoe from Foochow in southern China with which Busk compared it. Thus in the case of both skins and skulls the evidence of great superiority in size of the Manchurian tiger over the Indian tiger falls to the ground. All that can be claimed, in my opinion, is that they are sometimes bigger. Since, however, the two are racially distinguishable, the Manchurian may be given the name *amurensis*, used by Dode in 1871. The following are references to its literature :—

Panthera tigris amurensis, Dode.

Felis tigris var. *amurensis*, Dode, *Proc. Zool. Soc.* 1871, p. 480.

? *Tigris amurensis*, Satunin, *Neue Balt. Wiedemann.-blätter*, p. 73, 1907 ; *id. Conspect. Mamm. Imp. Ross*, 1914, p. 157.

All the characters for this race known to me are mentioned above. It remains only to justify the adoption of the name *amurensis* for it. Dode, when describing this tiger as distinguishable from the Indian tiger by having longer hair, paler colour and less pronounced stripes, stated that it occurs on the banks of the Amur river and of its tributary the Ussuri. He appears to have been in the northern corner of Manchuria where it is bounded on the North by the Amur and on the east by the Ussuri. Hence the western or left bank of the Ussuri in Manchuria may be taken as the type locality of *amurensis*. And since Dode's description of the type-skin of *amurensis* agrees with Swinhoe's description of the skin from Niu-chwang in the south of Manchuria and with Temminck's description of Korean skins, the reason for adopting *amurensis* for the Manchurian tiger becomes clear.

It seems to me to be doubtful if Satunin described the same race of tiger as *amurensis*. He does not state where his material came from except vaguely the most easterly portions of the Russian Empire, and he diagnosed it as differing from the Mongolian race in being more brilliantly coloured, in having the stripes more sinuous with irregular outlines and mostly duplicated, the general colour being reddish-yellow and the stripes deep black with silky lustre except a few on the outside of the thighs which are brownish. He also adds that this tiger is slightly smaller than the Caucasian tiger. This description may have been taken possibly from the skin of a Manchurian tiger in summer coat.

Again, the tiger figured by Elliot as an Amurland tiger and said to be a faithful likeness taken from one of Dode's skins which went to America, does not agree at all with Dode's description of his original specimen. It is unusually heavily striped and very dark in colour. It bears, indeed, suspicious likeness to the tigers of Northern and Central China, described below, and quite possibly Dode picked it up as a traded skin in the latter country.

Finally, I must refer to the reproduced photograph of a very interesting alleged Manchurian tiger-skin in the later editions of Rowland Ward's Records. The print is better in the 1910 edition than in the last. It represents a tiger with the stripes much broader and less broken up on the back, flanks and loins than in Swinhoe's Manchurian skin above described; but there is also a marked tendency for the failure of the stripes to pass on to the white of the chest and belly. This white, moreover, especially on the belly, is more extensive than in any tiger-skin I have seen. In the middle of the body, for example, the combined white areas exceed in width the coloured area that lies between them, whereas in Swinhoe's Manchurian skin, as recorded above, they are only about two-thirds the width of the median coloured area, a character in which this skin resembles approximately the skins of all ordinary tigers in which the white, in the living animal, is restricted to the lower side. In the tiger figured in the Records the white must have extended half way up the flanks. It will be noticed, too, in this figure that the coloured areas on the legs are reduced to narrow strips by the encroachment of the normal white on the inner side over the back and front of the leg. Judging from the photograph, too, which, however, may be deceptive on this point, the coloured area, of the skin is much darker than in Swinhoe's and in the Duke of Bedford's skins and in the mounted specimen in the British (Natural History) Museum. The photograph of this skin, indeed, is no doubt responsible for the statement, often repeated in accounts of the Manchurian tiger, that this race is distinguished by the larger extent of white on the under parts and inner side of the limbs, a statement which is not true at all events of all Manchurian skins.

It may be found, for instance, in Lydekker's text to Kuhnert's *Animal Portraiture*, in which there is a coloured plate of two ' Siberian or Manchurian tigers ' in the snow.

On the evidence, the tiger-skin above referred to cannot be assigned to the Manchurian race (*Panthera tigris amurensis*), as understood and described in this paper. Nor can it be assigned to the Mongolian race so far as the latter is known to me. This race may take the name *longipilis* in a restricted sense. Its synonymy is as follows :—

Panthera tigris longipilis, Fitzinger

The Mongolian Tiger

Felis tigris mongolica, Lesson, *Nouv. Tabl. R. Anim.*; *Mamm.* p. 50, 1842 (name unaccompanied by description and hence unavailable).

Tigris longipilis, Fitzinger, *SB. Kais. Akad. Wien.* 58, pt. 1, p. 455, 1868 (in part).

Felis tigris longipilis, Matschie, *SB. Ges. Nat. Fr. Berlin*, 1895, p. 195 (in part).

Tigris mongolica, Satunin, *Conspect. Mamm. Imp. Ross.*, p. 157, 1914.

Fitzinger gave the name *longipilis* to the tigers ranging from the Caucasus eastwards through the Russian territories of Central Asia. A few years later Dode eliminated the Amurland tiger as *amurensis* and subsequently Matschie distinguished the Transcaspian tiger as *virgata*, thus leaving the name *longipilis* as applicable to the tigers of the intermediate area. Satunin appears to have been the first author to attempt to diagnose the three races under the names *septentrionalis*, *mongolica* and *amurensis*. According to him the Mongolian tiger is intermediate in characters, as it is in distribution, between the other two, but his diagnosis is not very convincing and is very brief. He states that the hairs are very long so that the tail appears very bushy. The colour is pale and dull with the stripes often indistinct and pale brown on the posterior part of the body as in the Transcaspian race (*septentrionalis*). The colour is less brilliant than in *amurensis* and the stripes are less sinuous.[1]

It must be remembered, however, that there is some doubt whether the tiger Satunin described as *amurensis* is precisely the same as the one to which, for reasons given above, I have restricted the name *amurensis*, namely, the Manchurian tiger ; and it is obvious that Satunin's description of *mongolica* applies very closely to the skin of Mr. Swinhoe's tiger which is known to have come from Manchuria. I have never seen a skin which, so far as I know, unquestionably came from Mongolia; and until properly localized material comes to hand from the two countries, I can throw no further light on the matter.

As regards the size of the Mongolian tiger nothing seems to be precisely known. In Rowland Ward's Records, 1928, p. 478, five alleged Mongolian dressed skins measure 13½ ft., 12 ft. 4 ins., 12 ft. and 11 ft. 3½ ins. respectively. But of these it is only the first mentioned that exceeds the length of dressed skins of Indian tigers recorded in the same volume. Satunin's silence on the point shows that he was not impressed by the size of the Mongolian tigers he presumably knew; and it must be admitted that the positive evidence in favour of the claimed great superiority in size of Mongolian tigers over North Indian tigers amounts to very little. For example, Ehrenberg (*Ann. Sci., Nat.*, vol. xxi, pp. 391–394, 1830) described two alleged Siberian tigers in captivity in Moscow as ' far from attaining the size of the Bengal tiger ' from the published statements regarding the latter. The size of the Bengal tiger, has, however, been greatly exaggerated, as we know ; and if Ehrenberg was acquainted with records of this tiger standing 4 ft. or thereabouts at the shoulder, he may well have been impressed by the comparatively small stature of even big Siberian specimens. He described these two tigers as having a rudimentary mane and as being a little longer in the coat, much paler in colour, with fewer, browner stripes than a skin obtained between the Upper Irtish and the Kirghiz Steppes, lat. 48°N. The living animals agreed very closely with Satunin's description of the Mongolian tiger; but the skin with which they were compared is not easy to classify. It may, however, have been a skin of the same race in summer coat, colour being described as 'an agreeable reddish-yellow' and the length as 6½ ft. from the nose with root of the tail, which was 2 ft. 5 ins. but defective, the total being only a little over 9 ft., making allowance for the missing 2 or 3 ins. of the tail. The sex was unrecorded.

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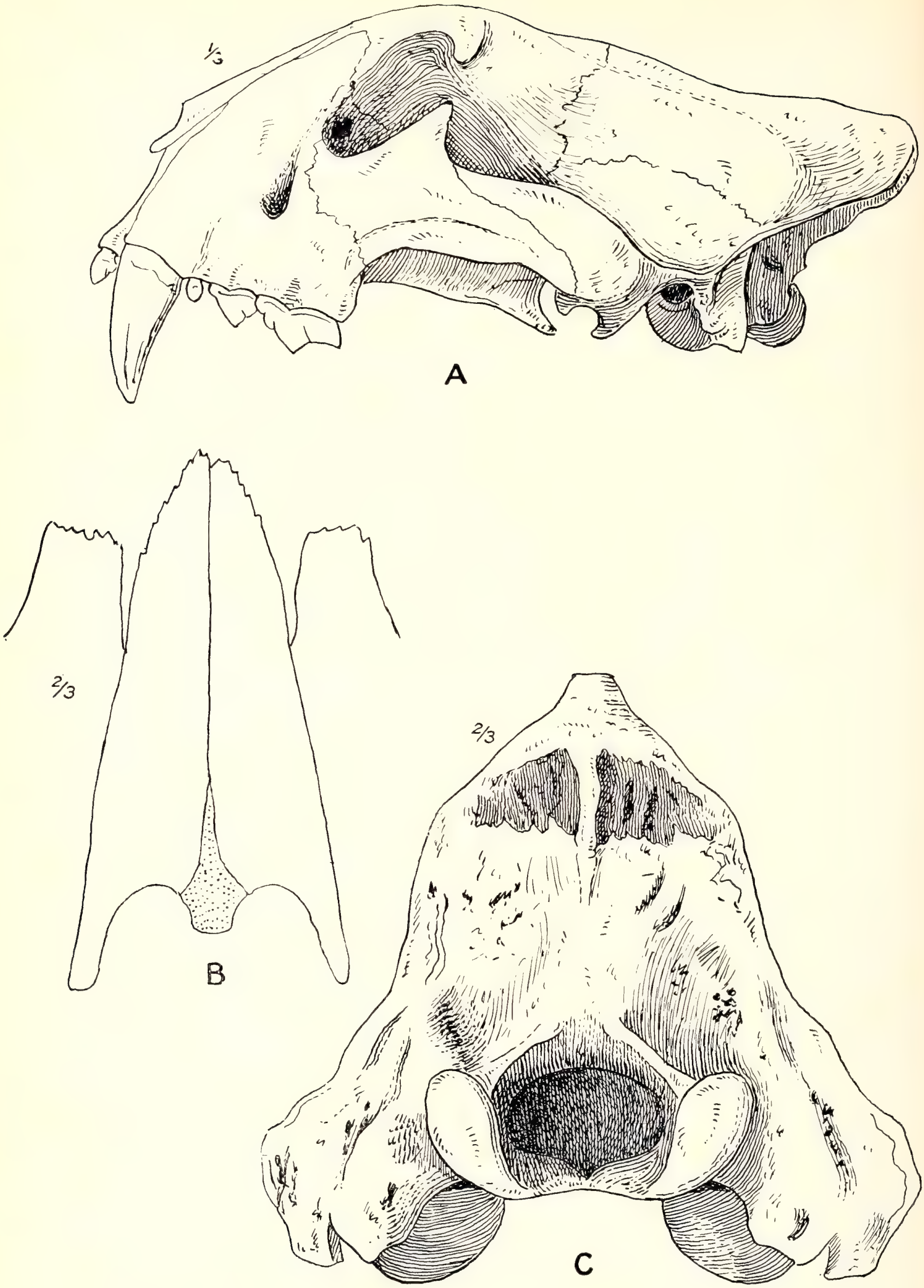
[1] I am indebted to Mr. Uvarov, of the Imperial Bureau of Entomology, for kindly translating for me the Russian text of Satunin's paper quoted above in the synonymy

Finally, the tigers of North and Central China have to be dealt with in this section.

I am informed by Messrs. Poland & Sons, the well-known wholesale furriers, that tiger-skins exported from China belong to two readily distinguishable types. The first, known as Manchurian, are large, thickly furred, shipped from Shanghai; and those known as Hankau (Hankow) skins, are smaller, shorter coated, more richly striped and darker in tint.

I referred above to a tiger-skin recorded by Milne-Edwardes from North China which was described as having the yellow colour of the back browner (*plus brune*) than in Indian, Cochin-Chinese and Javan tigers, and Dunbar Brander states that 'tigers found in China (and the Malay Peninsula) always struck me as being smaller and having a tendency to be darker than Indian tigers.'

During a recent visit to Messrs. Poland's fur store I was given the privilege of seeing a large number of the so-called Hankow skins shipped from Shanghai. They were all untanned skins which had been pegged out to dry; but the measurements of four of the biggest were only 9 ft. 9 ins., 9 ft. 8 ins., 9 ft. 4 ins. and 9 ft. 3½ ins. approximately, whereas a small skin with a defective tail, probably that of a tigress I estimated at 7 ft. 10 ins. allowing from 9 to 12 ins. for stretching they were obviously small as compared with the Manchurian tigers known to me, and much darker coloured, much more heavily striped and much shorter in the coat. They were more like Indian tigers but were on the average decidedly smaller, and darker and more fully striped, with a somewhat longer and softer coat. The length of the coat was variable. In one specimen at least it was almost intermediate in length and thickness between average Indian and Manchurian skin. The tint was also variable as well as the pattern which consisted sometimes of stripes mostly looped, or diamond-shaped with darker centres, sometimes unlooped and sometimes complete from the nape on to the fore leg, sometimes interrupted. The extent of white on the belly as compared with the coloured area was variable. On the average it was about a half or two-thirds; but in one specimen the two combined white areas were equal to the rusty brown area between them. This specimen comes in that particular nearer than any to the alleged Manchurian skin figured by Ward and referred to above, but the white on the limbs was normal in extent.



A. Skull of Tiger (*Panthera tigris styani*) from North China.
B. Nasals and summit of maxillæ of the same.
C. Posterior view of occiput of the same.

This Chinese tiger appears to me to be sufficiently well defined to be worth distinguishing nominally as a local race, which I propose to name in memory of Mr. Styan to whom the British Museum is indebted for much zoological material from China.

Panthera tigris styani, subsp. nov.

Differing from the average tiger of Northern India in being smaller, somewhat darker and more closely or heavily striped and longer in the coat, probably in winter; and from the Manchurian tiger, as known to me, in being smaller, much darker and more fully striped and in having a shorter less woolly winter coat.

Distribution.—Northern and Central China. No doubt blending southwards with the tigers of Southern China, Siam, etc., the skins of which are unknown to me.

As the type of this sub-species I select a skull ticketed North China, whence it was brought by Mr. F. W. Styan (B. M. No. 8.8.11.20.).

Mr. Styan collected in many parts of China ; but not, so far as I am aware, to the north of Pekin. He brought back two skulls whose measurements are as follows :—

	English Inches.					Millimetres.		
Loc. and Sex.	Total length.	Cond. bas. length.	Zygom. width.	Nasals.	Occiput.	Upper carn.	Lower carn.	Base of canine.
N. China ♂ ...	$13\frac{1}{5}$	$11\frac{4}{5}$	$8\frac{3}{5}$	$4\frac{2}{5} \times 2\frac{2}{5}$	$2\frac{2}{5}$	35	27	28
,, ,, ♂ ..	$12\frac{9}{10}$	$11\frac{1}{5}$	$9\frac{1}{10}$	$4\frac{3}{10} \times 2\frac{1}{5}$	$2\frac{9}{10}$	32	26	28

It will be noticed that these skulls agree very closely with the Manchurian tiger-skull measured by Busk. They are smaller than the average skulls of North Indian tigers ; and perhaps about the size or a shade larger than those of South Indian tigers ; but the data are too scanty to form an opinion on that point. In both the skulls the forehead is well vaulted as in typical Indian tigers ; but in neither is the median crest on the summit elevated over the occiput as is usually at all events the case in Indian tigers. But until further material comes to hand, no great reliance must be attached to this character. (Pl. G.).

It may be seen from the table that the shorter of the two skulls, the type, is broader across the zygomatic arches than the longer. It is also heavier and altogether more robust, being noticeably wider across the forehead from the postorbital processes to the lower edge of the orbit. Provisionally these characters must be regarded as purely individual, although they impart a considerable difference to the two skulls when viewed from the front or above.

This tiger is the same, perhaps as the one Matschie described as the tiger of the Hoang-ho watershed. (*SB. Ges. Nat. Fr. Berlin,* 1879, pp. 13–17).

THE TIGERS OF BURMA, ASSAM AND THE MALAY PENINSULA

Dunbar Brander states that tigers found in China and the Malay Peninsula always struck him as being smaller and having a tendency to be darker than Indian tigers.

In the British Museum, apart from a few skulls, there is practically no material upon which to form an opinion, apart from the mounted fore-quarters of a specimen from the Federated Malay States which in colour and shortness of coat would pass anywhere for a small Indian tiger, although erroneously ascribed by Lydekker to the Sunda Island race. Similarly there were formely in the Zoological Gardens a pair sent by Major Bigge Wither from Yamethin in Burma which were exactly like Indian tigers, but perhaps rather on the small side. On the other hand I have seen several examples exported from the Malay Peninsula which in their darker coloration, copious whiskers and small size were unmistakably like the specimen from Deli in Sumatra referred to below except that the typical pale areas were normally white instead of washed with buff and the stripes fewer and more spaced. (Pl. F, lower fig.)

In Rowland Ward's *Records* (1928) there are field measurements of four tigers' skins from the area under discussion, namely, one from Annam (H. A. White) measuring 10 ft. 7 ins., as big as most Indian tigers; two from Assam, one (R. Erskine Scott) measuring 10 ft. 2 ins., and one (A. Simmonds) 10 ft. and ½ an inch, both rather below the average of Indian tigers; and finally one from Siam (Col. C. H. Stockley) 9 ft. 3 ins.. This specimen was unfortunately neither sexed nor stated to be mature. If a tigress and mature she was on the small side as compared with Indian tigresses; if a mature tiger he was no bigger than the Sunda Island races, to one of which he may have belonged. It cannot, however, be claimed from the data supplied by these skins that the tigers to the east of the Bay of Bengal are smaller than those to the west of it, although, as stated above, I have seen tigers shipped from the Malay Peninsula which in size and appearance suggested the occurrence of the smaller Sumatran or Javan race on the mainland. Shortridge, on the other hand, recorded a tiger, shot at Bankachon in Tenasserim, which, although considered large for the district, only measured just over 9 feet in total length. But the head and body were short, only 6 feet (1,800 mm.), the tail being relatively exceptionally long, namely a little over 3 feet (920 mm.). (*Journ. Bomb. Nat. Hist. Soc.*, May 25, 1915, p. 709).

The evidence supplied by the dimensions of the skulls in the following table also points to the tigers of these countries being of average size :—

	English Inches					Millimetres		
Loc. and Sex	Total length	Cond. bas. length	Zygom. width	Nasals	Occiput	Upper carn.	Lower carn.	Base of canine
Annam ♂ ...	$15\frac{1}{2}$	...	$11\frac{1}{2}$	...	...	...	...	...
Annam ♂ ...	$12\frac{7}{10}$	$11\frac{2}{5}$	$8\frac{3}{5}$	$4\frac{1}{5} \times 2\frac{1}{5}$	$2\frac{9}{10}$	35	28	26
Assam ♂ ...	$15\frac{3}{16}$	...	...	...	...	...	...	...
Assam ♂ ...	$14\frac{3}{8}$	...	$9\frac{1}{2}$	...	...	...	...	...
Assam ♂ ...	$13\frac{9}{10}$	$12\frac{1}{5}$	$9\frac{3}{10}$	$4\frac{1}{2} \times 2\frac{3}{10}$	$3\frac{1}{5}$	37	28	27
Upper Chindwin ♂	$13\frac{1}{5}$	$11\frac{9}{10}$	$9\frac{3}{10}$	$4\frac{1}{2} \times 2\frac{3}{10}$	$2\frac{3}{5}$	34	26	27
Perak ♂ ...	$13\frac{3}{5}$	12	$8\frac{9}{10}$	$4\frac{7}{10} \times 2$	$2\frac{9}{10}$	33	...	26
Johore ♂ ...	$14\frac{3}{8}$	...	$9\frac{1}{2}$	...	...	...	...	...
Burma ♀ ...	$11\frac{7}{10}$	$10\frac{1}{2}$	$7\frac{8}{10}$	$3\frac{9}{10} \times 1\frac{9}{10}$	$2\frac{6}{10}$	33	24	22
Mergui ♀ ...	$11\frac{7}{10}$	$10\frac{1}{2}$	8	$3\frac{7}{10} \times 1\frac{9}{10}$	$2\frac{3}{5}$	33	25	23

This table includes the measurements of four skulls from Rowland Ward's *Records*, namely, one from Annam and two from Assam, whose skins are referred to above, and one from Johore. These are as big as average Indian tigers' skulls or bigger. But the full measurements of the skulls in the British Museum show that the average is smaller all over, the total length, for example, averaging a little over 13 inches. It may be that the sportsmen who shot the tigers were aware of their exceptional size for the district and sent the skulls to Rowland Ward on that account. It is, however, interesting to note the occurrence at Johore, in the extreme south of the Malay Peninsula, of a tiger as big, judging by his skull, as an average Indian tiger.

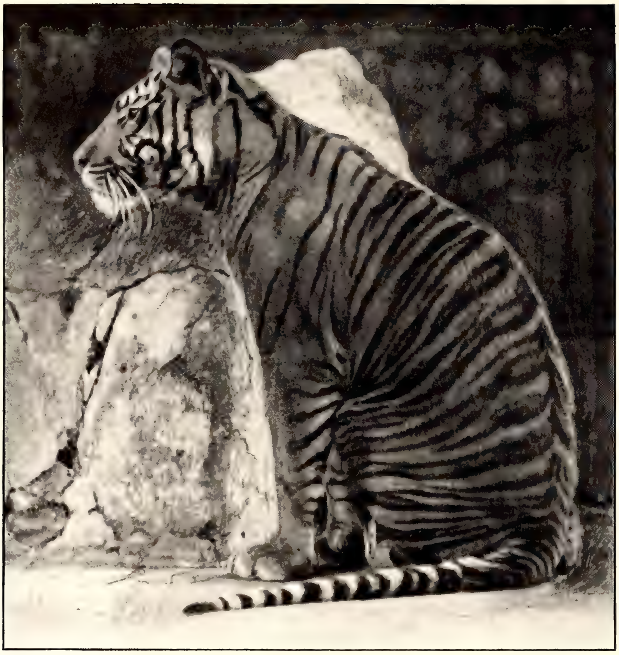
The skull from Annam was brought with an immature specimen by Dr. Vassal from Nahtrang ; the one from Upper Chindwin was presented by Mrs. Manby ; the one from Assam by Mr. M. Maxwell, and the one from Perak by Mr. I. C. Ford.

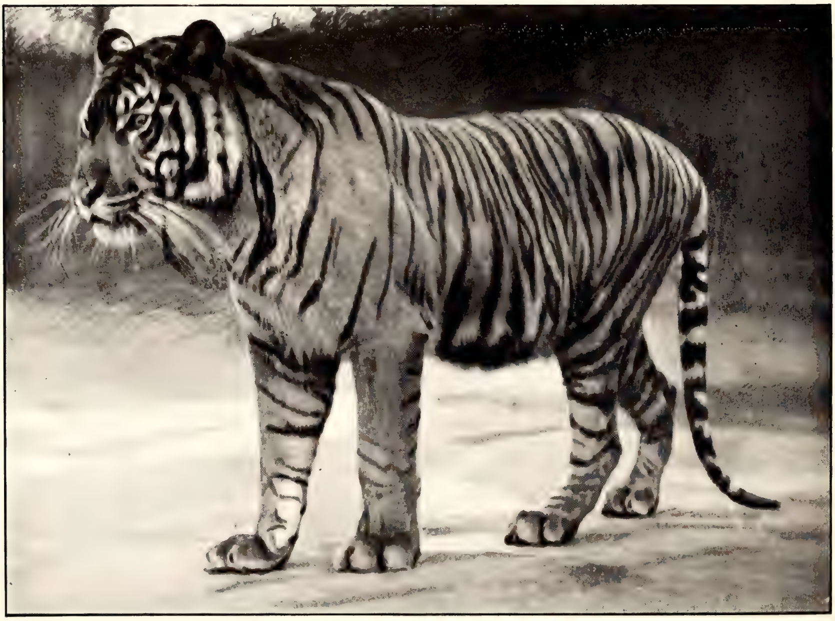
The female skull from Mergui, presented by Dr. Oldham, is about the same size as that of an Indian tigress. The only noticeable character about it is the slight extent to which the nasals overlap the maxillæ. The one from Burma was obtained for the Mammal Survey by Mr. J. M. D. Mackenzie.

THE TIGERS OF THE SUNDA ISLANDS

Accounts of the tigers of the Sunda Islands reveal great diversity of opinion regarding their status and characters. If regarded as distinct from the typical form from India, they were formerly quoted comprehensively as *sondaica*. But Schwarz in 1912 restricted that name to the Javan tiger and distinguished three local races, one from Sumatra, one from Java and one from Bali, the material he had to work upon being :—a skin and a skull (♂) from Deli in Sumatra, a skin and four skulls (3 ♂, 1 ♀) from Java, and one skin and one skull (♀) from Bali. He left the Sumatran race without a special name, quoting it as *Felis tigris* subsp., called the Javan race *F. tigris sondaica* and the Bali race *F. tigris balica*.

In 1918 Robinson and Boden Kloss identified a tiger from Western Sumatra as *sondaica* and criticized Schwarz's separation of the Sumatran and Javan tigers as distinct subspecies. But they do not appear to have had either adequate material to work upon or, in all cases, direct access to the literature they quote. Kloss at all events in 1921, as a result of the examination of a number of skins, changed his opinion and came to the conclusion that the Sumatran tiger differs from the Javan and Bali tigers in being more heavily striped and in having less white beneath. He therefore referred the Sumatran tigers, with those of the Federated Malay States, to typical *F. tigris*, and the Javan and Bali tigers to *F. tigris sondaica*, rejecting apparently the name *balica* as based on insufficient material. This view was expressed in a note to a paper by Jacobson who quoted a long letter from Mr. B. Ledeboer about these tigers, giving some interesting, if at times, puzzling information about them. Mr. Ledeboer possessed over 100 skins from the three islands, all of which, he declared, show the same kind of stripes, the slight differences noticeable being due to age and mode of life. The tigers, for instance, living in lalang fields are lighter in colour than those inhabiting forests . . . and in very old tigers the stripes on the forepart of the body disappear altogether. This latter statement certainly does not apply to tigers from other parts of Asia ; but it is not so startling as Mr. Ledeboer's further declaration that a Sumatran tiger may be distinguished at a glance from a Javan tiger by having the throat, chest and belly unstriped and wholly whitish, whereas in the Javan animal the white of the under side is considerably reduced and invaded by the ends of the stripes from the sides. This is the first record of the absence of stripes from the under side in the species, and I do not believe it is true of any tiger, Sumatran or otherwise. At all events it is quite untrue of the specimen from Deli in Sumatra which I described in 1908. Also I may add that this tiger from Deli obviously represented a type which, by its smaller size and darker colour, could be distinguished at a glance from typical examples of Indian tigers. I published at the time a photograph of the living animal, and its skull is preserved in the British Museum. The tiger, however, had been reared in captivity from cubhood, and perhaps to that circumstance may be attributed certain abnormalities in the skull. Nevertheless the fact remains that in its wider, shorter nasal bones and differently shaped occipital plane, it resembles Kloss's Sumatran skull and differs from the skull of a tiger from Java in the characters Schwarz pointed out as distinctive of the two races. This Javan skull indeed can be picked out from all the tigers' skulls in the British Museum by the





[*Photo W. S. Berridge*].

Two views of Tiger, from Deli, Sumatra, in the London Zoological Gardens.

constriction of the occiput, giving it a narrow, nearly parallel sided aspect. Kloss explains this modification of the occipital bone as due to the action of the jaw muscles and apparently thinks it of no systematic importance. Nevertheless it does not occur to the same extent in any of the skulls of Persian, Indian, Chinese or Burmese tigers that I have seen, although, as might be expected, some skulls including the Sumatran skull show an approximation to it. Ledeboer, as cited by Jacobson, also states that full grown tigers from Sumatra, Java and Bali do not vary much in size. The males are much larger than the females; but the biggest obtained was only a little over 3 metres, about 9½ feet.

On the evidence available to me, however, I do not feel justified in dissenting from Schwarz's opinion that there are three races of tigers in the Sunda Islands: one in Sumatra, one in Java and one in Bali.

Panthera tigris sumatræ, subsp. nov.

The Sumatran Tiger

Felis tigris nigra, Lesson, *Nouv, Tabl. R. Anim.*, p. 50, 1842, (name unavailable, no description given).

Felis tigris sumatrana, Blainville, *Ostéographie*, vol. ii, Atlas pl. vii (skull) and explanatory text 1839-1864, (name preoccupied by *Felis sumatrana*, Horsf. 1824).

Felis tigris sondaica, Pocock, *Proc. Zool. Soc.*, April 1909, pp. 890–892, text-fig. 174 (living animal); Welch, *Proc. Zool. Soc.*, 1909, pt. 2, p. 892 (in part, Sumatran specimen).

Felis tigris, subsp. Schwarz, *Ann. Mag. Nat. Hist.* (8), x, p. 324, 1912; *id. Senckenberg Natfor. Ges.* 1913, pl. ii, fig. A (skull).

Felis tigris sondaica, Robinson and Kloss, *Journ., Fed. Malay States* viii, pt. 2, p. 8, 1918 (Specimen from Sungei Kumbang, W. Sumatra).

Felis tigris tigris, Kloss, *Journ., Fed. Malay States*, x, p. 237, 1921.

In the above-given synonymy I have assumed that there is but one race of tiger in Sumatra. And since, as may be seen, no valid name is available, I have been compelled to introduce a subspecific title because the only specimen I have seen of this tiger (Pl. H.) clearly represented a race distinguishable from Indian examples of the typical tiger (*Panthera tigris tigris*), and because on the available evidence the Sumatran race differs from the Javan in pattern and cranial characters.

The skin of the example I described and figured in 1909 was unfortunately not preserved. I have therefore made its skull, which is in the British Museum, the type of *P. tigris sumatræ*.

The following is the description of the example above referred to. It was an adult male, one of a litter obtained at Deli in Sumatra by Mr. Pinckney who presented it in 1908 to the Zoological Gardens where it died in 1912. Its ground colour was noticeably darker in hue than in the Indian and Manchurian tigers in the adjoining cages. The stripes were numerous, closely placed and broad, nearly all of those on the sides of the body behind the shoulders and on the hind quarters being looped or reduplicated. The shoulder was scantily striped, and the outside of the fore leg almost unstriped. The inner side of both fore and hind limbs was fully striped to the feet. The pale areas over the eyes, on the cheeks, chest, belly and inside of the limbs were only dirty white and not sharply defined from the yellow-brown hue of the rest of the body. The yellow-brown hue of the muzzle extended over the whisker-area down to the black patch round the corner of the mouth, separating the white patch on the front of the upper lip from the white of the cheek. The hairs forming the fringe on the cheek beneath the ear and those on the chin were long. This tiger was small, standing only about 29 inches at the shoulder, that is to say he was some 9 inches lower than the male from Manchuria recorded above and smaller in proportion all over. Except for the larger number and duplication of the stripes this tiger agreed with other Sumatran tigers that have been described. In his Monograph of the Felidæ Elliot, for example, states that Sumatran tigers are smaller than Indian tigers, their general colour being dark red and the pale areas buff instead of white. Mr. F. D. Welch also drew attention to the large development of the cheek-tufts in a young female from Sumatra, said to be one and a half years old; and according to Schwarz the skin he saw, also from Deli, the locality of the type, was somewhat paler than his Javan skin and had broader stripes, longer fur, a more distinct beard and a larger pale area above the eye.

As regards the size of the Sumatran tiger I may repeat that the living specimen, an adult male, stood only 29 inches at the shoulder, and Robinson and Kloss record the length of an old male from Sungei Kumbang in Sumatra as 8 feet 3½ inches, smaller, that is to say, than an average Indian tigress.

With regard to the skull, Schwarz does not mention any peculiarities distinguishing it from the skull of the typical tiger. He merely contrasts it with the skull of the Javan race from which, as he asserts, it may be readily distinguished by the shortness and width of the nasal bones and the shape of the occipital plane which is broader and more rounded along the margins; but he adds that the skull is somewhat smaller, markedly narrower across the cheeks and has smaller auditory bullæ and differently proportioned cusps on the upper carnassial tooth. But without more material, it would be unsafe to assume that all these characters constitute reliable and constant differences.

The only Sumatran tigers' skulls I have seen have the occipital plane and the wide nasal bones as described by Schwarz. But they are a little larger than the skull seen by Schwarz and are remarkably flat, the flattest and most lion-like tiger skulls I have examined. But since Schwarz would presumably have noticed a similar flatness had it occurred in his Sumatran specimen, its absence may be assumed. Possibly the flatness in the type specimen from Deli might have been attributed to the tiger having been reared from cubhood in captivity, a condition which is known to have, usually at all events, a profound effect on the shape of the skulls of Carnivora; but it is significant that the skull of the tiger obtained by Robinson and Kloss at Sungei Kumbang, and presented to the British

Museum, is almost as flat and lion-like, as shown in my figure of it. The carnassial and canine teeth too of the typical skull of this race are also very small; but this feature is probably I think, due to the conditions under which the animal was reared. (Pl. I, C, D; Pl., B, B.)

From the synonymy quoted above it will be seen that Blainville figured, under the name *Felis tigris sumatrana*, the skull of a tiger alleged by its collector, Duvaucel, to have come from Sumatra. The sex of the animal was unrecorded; but the skull has the short nasals and broad occiput of other known Sumatran skulls, accompanied by a moderately high and rounded forehead. In the table of measurements that follows I have given its dimensions as interpreted from the figures which are half the size of the original. Judging from its size, the skull was that of a male.

The following are the measurements of the two skulls in the British Museum and of the two in the Senckenberg Museum, Frankfurt, described by Schwarz, and of the specimen figured by Blainville:—

	English inches.					Millimetres.		
Loc. and Sex.	Total length.	Cond. bas. length	Zygom. width	Nasals	Occiput	Upper carn.	Lower carn.	Base of canine
Sumatra ♂ (Blainville)	$12\frac{3}{5}$	$11\frac{2}{5}$	$9\frac{4}{5}$	...	...	...	...	...
Sungei Kumbang ♂	$13\frac{2}{5}$	$11\frac{7}{10}$	9	$4\frac{1}{10} \times 2\frac{3}{10}$	$2\frac{4}{5}$	35	26	28
Deli (type) ♂ ...	$12\frac{4}{5}$	$11\frac{1}{10}$	9	$4 \times 2\frac{1}{5}$	$2\frac{4}{5}$	31	22	25
Deli ♂	$12\frac{1}{3}$	...	$8\frac{1}{4}+$	$4 \times 2+$	$2\frac{3}{5}$	...	...	...
Deli ♀	$10\frac{4}{5}$	...	$7+$	$3\frac{4}{5} \times 2$	$2+$	...	...	...

Although these measurements indicate that the average dimensions of the skulls of male Sumatran tigers are considerably less than those of male Indian tigers, nevertheless the skull from Sungei Kumbang is larger than would be expected in the case of an animal measuring in the flesh only 8 ft. 3½ inches in total length.

Panthera tigris sondaica, Fitz.

The Javan Tiger.

Tigris sondaica, Fitzinger, *S.B. Kais. Akad. Wien*, 58, pt. 1, p. 454, 1868; Welch, *Proc. Zool. Soc.* 1909, p. 892 (in part; Javan specimen); Schwarz, *Ann. Mag. Nat. Hist.* (8), x. p. 324, 1912; *id. Senckenberg Natfor. Ges.* 1913, pl. ii, fig. B (skull).

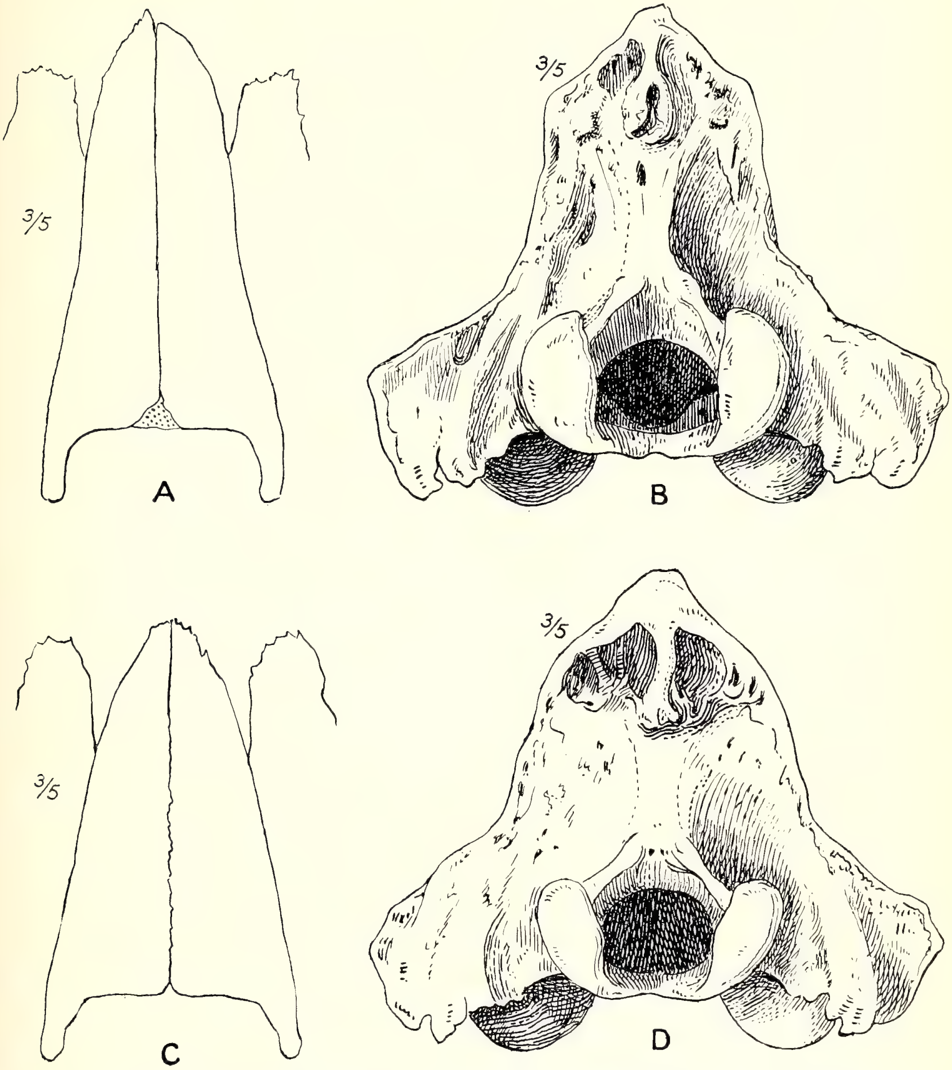
The name *sondaica*, formerly applied by most writers to the tigers of Sumatra and Java, was in 1912 restricted by Schwarz, as above stated, to the Javan animal because Fitzinger's description of the stripes as narrow applied to the Javan skin Schwarz saw better than to the Sumatran skin. According to Schwarz the Javan skin had much narrower stripes, shorter and closer fur and darker ground colour, with a smaller pale area above the eye. This description does not, however, agree with that given by Welch in 1910 of a Javan male exhibited in the Antwerp Museum, and believed to have been twelve years old. According to Welch, this tiger resembled the living example from Deli in Sumatra in pattern; but differed in the unusual development of the hair on the neck and head. The cheek-fringes and hair on the chin were very long and there were large tufts of hair growing from the inside of the ears and projecting at least three inches beyond their edge, recalling the ear-tufts of a horned owl. The hair on the nape and sides of the neck was quite five inches long and only a little shorter on the throat, and it formed a loose mane, terminating suddenly at the junction of the neck and body, the body and limbs being normally short-haired.

As described above, a small mat-like mane is sometimes present on the nape even in Indian tigers; but this Javan example is the only tiger on record with a mane recalling that of a lion and serving to eliminate the mane as one of the specific differences between the two species.

Schwarz, however, relied mainly on skull-characters for separating the Sumatran and Javan races of the tiger. The only indisputable material of the Javan tiger I have seen is the skull of an adult male from Probolingo presented to the British Museum by M. Maxwell; and this skull, with its greatly contracted occipital region and longer, narrower nasals, differs markedly from the two Sumatran skulls in the Museum and unquestionably bears out Schwarz's contention that the two races are distinct. The Probolingo skull is a little larger in every respect than that of the adult male recorded by Schwarz, and in its vaulted forehead and long nasals closely resembles the skull from Teluk Anson in Perak, referred to above. (Pl. I, A.B.)

But there are six additional skulls in the British Museum which, despite the unfortunate absence of locality, I refer to the Javan race because of their general agreement with the skull from Probolingo. Three of the skulls are those of adult males and three are females, one being fully and the others almost adult. Their history, so far as it goes, favours my determination of them. They were purchased in 1867 as part of the collection of Prof. Lidth de Jeude, of Utrecht in Holland, who is more likely perhaps to have received skulls of tigers from Java than from any other country.

In the following table I give the measurements of the skull from Probolingo and of the male and female recorded by Schwarz; and below these I have added the measurements of the six unlocalized skulls assigned to this race, the original owner's name in this case being substituted for the unknown locality.



A. Nasals and summit of maxillæ of Javan Tiger (*Panthera tigris sondaica*) from Probolingo.

B. Occiput of the same, showing marked compression.

C, D. The same bones of Sumatran Tiger (*Panthera tigris sumatræ*), from Deli.

	English Inches.					Millimetres.		
Loc. and Sex.	Total length.	Cond. bas. length.	Zygom. Width.	Nasals.	Occiput.	Upper carn.	Lower carn.	Base of canine.
Probolingo ♂ ...	13	$11\frac{2}{5}$	$9\frac{1}{2}$	$4\frac{2}{5} \times 2$	$2\frac{1}{3}$	34	25	27 –
Java ♂ ...	12^3	...	$8\frac{4}{5}$	$4\frac{1}{8} \times 2$	2 –	...	...	...
Java ♀ ...	$11\frac{3}{5}$	...	$7\frac{4}{5}$	$3\frac{4}{5} \times 1\frac{9}{10}$	$1\frac{9}{10}$	...	...	...
(L. de Jeude) ♂ ...	$12\frac{7}{10}$	$11\frac{1}{5}$	$8\frac{9}{10}$	$4\frac{1}{10} \times 2\frac{1}{10}$	$2\frac{1}{10}$	33	25	25 +
(L. de Jeude) ♂ ...	$13\frac{2}{10}$	$11\frac{7}{10}$	$9\frac{1}{5}$	$4\frac{3}{10} \times 2\frac{1}{5}$	$2\frac{1}{10}$	35	26	29
(L. de Jeude) ♂ ...	$12\frac{1}{2}$	11	$8\frac{9}{10}$	$4\frac{1}{10} \times 2$	$2\frac{1}{10}$	33	26	28
(L. de Jeude) ♀ ...	$11\frac{3}{10}$	$10\frac{1}{5}$	$7\frac{3}{5}$	$3\frac{4}{5} \times 2$	2	31	24	25
(L. de Jeude) ♀ ...	11	...	$7\frac{2}{5}$	$3\frac{1}{2} \times 1\frac{4}{5}$	$1\frac{9}{10}$	31	22	21
(L. de Jeude) ♀ ...	$10\frac{2}{5}$	$9\frac{3}{10}$	$6\frac{4}{5}$	$3\frac{2}{5} \times 1\frac{4}{5}$	$1\frac{9}{10}$	29	20	22

I do not think on the evidence that much reliance can be placed on Schwarz's contention that *sondaica* is a larger animal than *sumatræ* ; but the skull from Probolingo and the six belonging to the Lidth de Jeude Collection differ from the skull from Sungei Kumbang in their longer, narrower nasals, more compressed occiput, less inflated auditory bullæ and more vaulted forehead.

Panthera tigris balica, Schwarz.

The Bali Tiger

Felis tigris balica, Schwarz, *Ann. Mag. Nat. Hist.* (8), x, p. 325, 1912 ; *id. Senckenberg Natfor. Ges.* 1913, pp. 1–2, pl. 1 (skin), pl. 2, fig. *c* (skull) ; Boden Kloss, *Journ, Fed. Malay States*, x, p. 238, 1921.

According to Schwarz the skull of this race resembles that of the Javan tiger in its long narrow nasal bones and narrow occipital plane, but differs in having much flatter auditory bullæ and in its smaller size.

Only one female specimen, represented by a flat skin and the skull, was available for examination. From the tip of the nose to the root of the tail this skin measured 1530 mm., that is to say just over 5 ft. 1 in. the tail being 580 mm. or just over 1 ft. 11 in. giving an approximate total of 7 ft., much shorter, that is to say, than many leopards. Making allowance, however, for the considerably greater relative length of a leopard's tail, this tigress, so far as the head and body were concerned, was probably only as large as a big leopard. This conclusion is borne out by the following dimensions of the skull which are approximately equal to those of the skulls of large male African and Indian leopards, which may reach 11 inches or a little over in total length.

Locality and Sex.	Total length.	Cond. bas. length.	Zygom width.	Nasals.	Occiput.	Upper carn
Island of Bali ♀ ...	$10\frac{1}{6}$	9 –	$6\frac{4}{5}$	$3\frac{1}{2}$ – × $1\frac{1}{4}$	$1\frac{1}{4}$	30 +

Schwarz described the one skin of this race he examined as having broader and more duplicated stripes than the skin of the Javan specimen ; but Kloss, who saw four skins from Bali, stated that the stripes were narrower and fewer than in the Javan skins available to him. Probably there is no constant difference in pattern between the tigers of the two islands. It is likely enough that the Bali tigers may be smaller than the Javan, but at present it cannot be claimed that *balica* as a subspecies rests on a very secure basis.

SUMMARY

A brief summary of the characters of the races of Tigers as known to me and described in this paper may be of interest.

1. The Caspian race (*Panthera tigris septentrionalis*). Generally a medium sized or smallish tiger with a thick longish winter coat, dark in colour, with numerous, close-set stripes showing a marked tendency to brownness on the whole or parts of the body. From the eastern Caucasus to the Perso-Afghan boundary. It is interesting to note that this race of tiger extends into Europe.

2. The Mongolian race (*Panthera tigris longipilis*). This tiger is unknown to me, but is said to be intermediate between the Caspian race and the Manchurian or Amurland race which follows. Central Asia.

3. The Manchurian or Amurland race (*Panthera tigris amurensis*). Apparently larger than the Caspian race, but the evidence on this point is conflicting. Certainly much less richly coloured, the general hue being pale, and the stripes less numerous. The winter coat apparently thicker and longer. Manchuria from the Ussuri southwards. Probably Korea.

4. The Northern and Central Chinese race (*Panthera tigris styani*). Considerably smaller, shorter coated, more richly coloured and more heavily striped than the Manchurian race. Approaching the Indian form but rather smaller and with a longer softer coat. Northern and Central China, probably the watershed of the Hoang-ho.

5. The Indian race (*Panthera tigris tigris*). Very variable and imperfectly known, but the typical form from Bengal is a large, rich-coloured, well striped, short and smooth coated animal, larger than the Central Chinese tiger and nearly if not quite as large as the Manchurian. India and Further India.

6. The Sumatran race (*Panthera tigris sumatræ*). Smaller than the Bengal race and more fully striped, with the white less conspicuous and the skull typically apparently flatter. Sumatra.

7. The Javan race (*Panthera tigris sondaica*). Apparently closely resembling the Sumatran race in size and coloration, but distinguished from it, and from all other tigers, by the marked constriction of the occiput. Java.

8. The Bali race (*Panthera tigris balica*). Resembling the Javan race but smaller.

NOTES ON THE BIRDS OF COORG

BY

F. N. BETTS

In the following notes, I have tried to make as complete a list as possible of the birds of one district of Coorg. Its comprehensiveness is limited however, by the fact that it is entirely the result of personal observation over a very limited area in the short period of a year and a half. Very few birds have been shot and handled and in consequence it has been impossible in many cases to identify the subspecies with any certainty. Besides some families, notably the warblers and babblers, are, by reason of their skulking habits and sober colouring, very hard to observe and identify and the list of these is almost certainly incomplete.

The Province of Coorg includes country varying tremendously in elevation and climate. On the West it runs down to the Malabar coastal plain, from whose dense, humid forests only two or three hundred feet above sea-level, tower up the Western Ghats rising to grassy summits nearly 6,000 feet in height. These hills and their western slopes experience a huge rainfall. To the east there is a well-wooded, undulating plateau of average elevation about 3,000 feet, with a fair rainfall and permanent streams, which is almost entirely under cultivation, chiefly paddy, coffee and oranges. Further east still is a range of low hills, rising to 4,000 feet covered in dense bamboo jungle. Beyond these lies the dry, hot Mysore plateau and the jungle is low thorny scrub.

The notes refer chiefly to the central plateau of the province and especially to the country round Pollibetta and Sidapur lying on the southern bank of the River Cauvery.

As regards migrants, there are two categories. There appear to be no summer migrants of any description. The true winter migrants, birds breeding in the far North, seem to arrive first in Mysore and do not usually spread westwards into Coorg for a fortnight or so. Besides these, there appears to be a considerable amount of local migration, east and west, a number of species occurring here during the cold weather but departing before the breeding season whilst they may be seen in Mysore at all seasons of the year. Notable examples are the Common King Crow and the Common Bee Eater.

1. **Corvus coronoides.** The Jungle Crow.
Common everywhere around human habitations, occurring also in the jungle though in smaller numbers.

2. **Corvus splendens splendens.** The Common Indian House Crow.
Uncommon. Only a few odd pairs may occasionally be seen in villages apparently living quite in harmony with the Jungle Crow.

3. **Dendrocitta rufa.** The Indian Tree Pie.
Fairly common. It is often to be seen in pairs or small parties in the tops of tall trees. It appears to be exclusively arboreal and is rather shy. It is a noisy bird, most of its calls being harsh but it has a flute-like note very similar to the cry of the Indian Oriole.

4. **Parus major mahrattarum.** The Southern Grey Tit.
Fairly common, one or two may often be seen in the mixed blocks of small birds, Minivets, White-eyes, Pied Shrikes and Nuthatches that roam through the tree tops. A breeding resident.

5. **Machlolophus xanthogenys.** The Southern Yellow-cheeked Tit.
Commoner than the last species. It usually goes about in small parties often in company with other small insectivorous birds. It appears to use old Coppersmith's nest holes high up in dead trees for nesting purposes. A quiet bird for a tit, having a low, jarring note.

6. Sitta frontalis. The Velvet-fronted Blue Nuthatch.
A common resident. A typical nuthatch running the tree trunks and branches like a mouse. It is exceedingly active and keeps up a continual cheeping call, usually occurs in small flocks or pairs.

7. Turdoides terricolor. The Southern Jungle Babbler.
Fairly common. A skulking, noisy bird, always going about in flocks of six or seven birds, keeping very much to thick undergrowth and jungle and very loath to fly far. It is far more often heard than seen.

8. Argya caudata. The Common Babbler.
Uncommon, though probably less than it appears, as it is a great skulker and does not come near gardens and cultivation, preferring the thick jungle undergrowth.

9. Pomatorhinus horsfieldi travancoriensis. The Southern Indian Scimitar Babbler.
Fairly common. It goes about in small flocks and has a loud hooting call and is exceedingly noisy when disturbed or frightened. It appears to be more arboreal than most Babblers and may often be seen high up in the trees.

10. Pellorneum ruficeps. The Spotted Babbler.
An extremely shy little bird haunting thick undergrowth and hardly ever seen. A nest I found, however, on April 15, 1928, containing two hard set eggs, was quite in the open in a heap of dead leaves at the foot of an anthill and was a deep little cup, made of dry leaves and domed with the same and lined with a few black rootlets.

11. Rhopocichla atriceps. The Black-headed Babbler.
Very common in all dense marshy jungles, and thickets near streams, in reed beds and bamboo jungle. A shy bird but noisy, continually uttering its whirring alarm note. The nests may be found in large numbers in such jungles at any time of the year, mere rough balls of bamboo leaves and reeds about nine inches in diameter, so loosely put together that they fall to pieces at a touch. They are stuck in any bush or patch of grass three or four feet from the ground. Only a very few of these nests ever contain eggs and one may often find a number of half built or incomplete nests within a few yards of each other, suggesting that these birds build spare nests for roosting like wrens.

12. Ægithina tiphia. The Common Iora.
A common resident, usually seen in pairs or small family parties. It has a great variety of notes including a very tit-like alarm cry. It is entirely arboreal and haunts open jungle and gardens. A nest was found with newly-hatched young in a coffee bush at the end of August.

13. Chloropsis aurifrons davidsoni. The Malabar Chloropsis.
A very common resident. It is a sweet songster and a great mimic. It usually goes about in small flocks in the tree tops. It is very fond of any honey-bearing flowering trees, especially *Erythrinas*, searching the blossoms either for the honey or the insects attracted.

14. Microscelis psaroides ganeesa. The Southern Indian Black Bulbul.
An occasional wanderer into the district but decidedly uncommon. It is a bird of higher elevations and doubtless is common on the higher peaks of the Ghats. A restless, strong-flying bird haunting high trees in small flocks. It is extremely noisy and has a very harsh voice.

15. Molpastes hæmorrhous hæmorrhous. The Ceylon Red-vented Bulbul.
Not very common though a widely distributed breeding resident.

16. Otocompsa emeria fuscicaudata. The Southern Red-whiskered Bulbul.
One of the commonest and most conspicuous birds of the district, abounding everywhere except in dense jungle. May be found breeding at almost any time of the year, making its nest in any low bush, often quite in the open with very little concealment.

17. **Iole icterica.** The Yellow-browed Bulbul.
Common but not conspicuous. It shuns the haunts of man and inhabits the edges of thick jungle. It is usually seen in pairs and has a low, sweet whistle uttered on the wing but is otherwise very silent.

18. **Pycnonotus gularis.** The Ruby-throated Bulbul.
A rather scarce resident ; living in dense jungle and very shy. It has a very pretty tinkling call of half a dozen notes, really a song and far superior to the efforts of the common bulbuls.

19. **Microtarsus poliocephalus.** The Grey-headed Bulbul.
Common in heavily-wooded swampy jungles. It keeps to the trees and is shy and hard to observe. It has one continually uttered wheezy call note.

20. **Larvirora brunnea.** The Indian Blue Chat.
A rare winter migrant. Once seen on November 22, 1927.

21. **Saxicola caprata atrata.** The Southern Stone Chat.
Not very common but sometimes to be seen in pairs in open cultivated fields and dry paddy land.

22. **Saxicoloides fulicata fulicata.** The Black-backed Indian Robin.
Very rare here. Only one doubtful record.

23. **Copsychs saularis saularis.** The Indian Magpie Robin.
A very common breeding resident and one of the best songsters.

24. **Kittacincla Macroura indica.** The Indian Shama.
Not uncommon but local It is a much shyer bird than the Dayal and keeps to the jungle. It is a beautiful songster and is decidedly crepuscular, being most active at dusk and singing when almost every other bird has gone to roost. It feeds much on the ground and in low bushes.

25. **Turdus merula simillinus (?)** The Nilgiri Blackbird.
A blackbird of some subspecies is a scarce resident, extremely shy and never leaving dense cover. Its head is noticeably darker than the body which agrees with ***'simillimus'*** but its habits are very different from the blackbird which occurs on the Nilgiris, where it is tame and fearless, inhabiting quite open country.

26. **Geocichla citrina cyanotis.** The White-throated Ground Thrush.
A fairly common resident in shady, well-wooded parts. It appears to spend a lot of its time in the trees though finding much of its food by scratching among the leaves on the ground. It has a very pretty, though not very powerful song, reminiscent of the Song Thrush, during the hot weather and usually sings from a perch well up in a tree.

27. **Oreocincla dauma nilgiriensis.** The Nilgiri Thrush.
Rare. An extremely shy bird keeping to jungle with dense undergrowth.

28. **Monticola cinclorhyncha.** The Blue-headed Rock Thrush.
A common winter migrant. The males seem greatly to outnumber the females. It is a solitary bird, haunting wooded country and keeping to the trees. Earliest date of arrival October 27.

29. **Monticola solitaria pandoo.** The Indian Blue Rock Thrush.
An occasional winter visitor. One bird lived for the whole of 1927-28 cold weather on or about a large store shed, spending most of its time on the ledges under the eaves and never going far away from it.

30. **Siphia parva parva.** The European Red-breasted Flycatcher.
A fairly common winter migrant, haunting open shady woods. It is shy and has one continually uttered little grating call note. The birds seem to be all females or immature specimens. I have never noted a fully developed male. A young one I shot was just growing red on the throat.

31. **Cyornis tickelliæ tickelliæ.** Tickell's Blue Flycatcher.
A fairly common little bird inhabiting shady woods, orchards, etc. It is quite tame and has a pretty little song somewhat reminiscent of a hedge sparrow. A pair had a nest with young in June 1928 in an old barbet hole in a broken off branch of a big tree some 35 feet up.

32. Cyornis pallipes pallipes. The White-bellied Blue Flycatcher.
Fairly common in the same sort of localities as Tickell's Flycatcher. Very similar in habits.

33. Alseonax latirostris poonensis. The Indian Brown Flycatcher.
Fairly common and resident. A very quiet and unobtrusive little woodland bird.

34. Terpsiphone paradisi paradisi. The Indian Paradise Flycatcher.
Resident but not common. A shy and quiet bird inhabiting shady woodland country.

35. Hypothymis azurea sykesii. The Madras Black-naped Flycatcher.
Very scarce. Only twice seen.

36. Lanius schach caniceps. The Southern Rufous-backed Shrike.
Uncommon. Occasionally seen in the drier parts of the country in open parkland or at the edges of dried paddy fields.

37. Lanius cristatus cristatus. The Brown Shrike.
An exceedingly common winter migrant from September to the end of March, occurring almost everywhere even in forest. It is an active, noisy bird with a singularly harsh voice. It is a typical shrike in its habits, hunting from some outstanding perch on a fence or tree whence it flies out and catches its insect prey, either on the ground or in the air. Earliest date seen September 11.

38. Hemipus picatus picatus. The Black-backed Pied Shrike.
A common resident. These birds are very like Flycatchers in their habits and usually go about in pairs or small flocks, often in company with minivets. They nest about April, building high up in dead or leafless trees. The nests are minute cups glued on top of a branch and are almost impossible to detect from the ground and usually quite inaccessible if seen.

39. Tephrodornis pondiceriana pondiceriana. The Common Indian Wood Shrike.
Not common. May be seen occasionally in small flocks hunting through the trees.

40. Pericrocotus speciosus flammeus. The Orange Minivet.
A common resident and one of our most striking birds, the scarlet males contrasting vividly with the bright yellow females. Usually seen in flocks of both sexes though fully plumaged males are in the minority. It appears to breed very late in the season, the winter flocks not breaking up till May or June and I found a nest in the Nilgiris in September.

41. Pericrocotus erythropygius. The White-bellied Minivet.
Common though not so numerous as the last species, which it much resembles in habits.

42. Lalage sykesii. The Black-headed Cuckoo Shrike.
Common in the winter months in well-wooded cultivated land but it disappears about the end of March probably retiring to the jungle to breed. A silent bird.

43. Graucalus macei macei. The Large Indian Cuckoo Shrike.
A common resident. In the off season it forms small flocks, keeping to high trees in the open. It has a very harsh, ill-tempered call rather like some of the harsher notes of the Oriole.

44. Artamus fuscus. The Ashy Swallow Shrike.
Locally common. In the evenings they collect in large flocks on tall trees and thence sail forth to catch flies with constant harsh, chattering cries. They are especially active after showers when a flight of termites occurs. I have seen them chase and mob a Shahin Falcon.

45. Dicrurus macrocercus. The Black Drongo.
Exceedingly common in the cold weather but they disappear almost entirely in the hot weather and do not become numerous again until September. It seems doubtful if they breed in the district.

46. Dicrurus leucophæus subsp. The Grey Drongo.

This bird of which I have been so far unable to shoot a specimen, is moderately common here. It appears to be almost as dark as the Black Drongo but is considerably smaller and has a comparatively much shorter tail which is only slightly forked. It is exactly similar to the Black Drongo in habits and like that bird disappears almost entirely in the breeding season.

47. Chibia hottentotta hottentotta. The Indian Hair-crested Drongo.

Rare. I have only seen this species on two or three occasions, always in pairs. Its distinctive marks are its large size and its almost square tail with upturned outer feathers.

48. Dissemurus paradiseus malabaricus. The Malabar Large Racket-tailed Drongo.

A common resident in the wooded parts of the district. They appear to pair for life and keep together throughout the year. Each pair owns a considerable territory and allows no trespassers of their own species on their domain. In spite of their size and pugnacity, however, I have seen one attacked and fleeing from a common Black Drongo. They do not seem to wander much and remain in their breeding haunts all the year round. They are very late in going to bed and may be seen hawking insects from some high dead tree until well after sunset when all the other diurnal birds have gone to roost. Their prolonged tail feathers make a characteristic humming noise in flight which can be heard at a considerable distance.

49. Orthotomus sutorius sutorius. The Indian Tailor Bird.

An extremely common resident though far from noticeable, except in the breeding season when their loud calls resound everywhere. They are late breeders, not nesting in any numbers till well after the monsoon has broken in July.

50. Cisticola juncidis cursitans. The Streaked Fantail Warbler.

Very common in all paddy fields and long grass bordering on them.

51. Prinia socialis. The Ashy Wren Warbler.

Scarce.

52. Phylloscopus sp. The Willow Warbler.

Some form of Willow Warbler, which I have been unable to identify, is a common winter migrant.

53. Irena puella. The Fairy Blue Bird.

Fairly common in the cold weather. Earliest date noted November 26. It haunts woodlands and gardens keeping to tall trees and has a very pretty bubbling whistle. It is entirely arboreal and is apparently mainly frugivorous being fond of various kinds of wild figs.

54. Oriolus indicus. The Black-naped Oriole.

One bird, a very brightly coloured female, seen on February 7, 1929.

55. Oriolus oriolus. The Indian Oriole.

Very common in the cold weather from about the end of October but they all depart about the end of March. Earliest record October 23.

56. Eulabes religiosa. The Southern Grackle.

Common in all wooded parts of the district. They are very noisy birds making the most extraordinary wheezes and chuckles interspersed with loud whistles of a remarkably human 'timbre'. They breed in colonies in natural hollows or old woodpecker holes in high trees.

57. Acridotheres tristis. The Common Mynah.

One of our commonest birds, swarming wherever there is cultivation but shunning the jungle. In the cold weather they gather in vast flocks to roost in reed beds. It is a most interesting sight to see them leaving these communal roosting places in the early morning. The various flocks burst out with a rush of wings, one by one in most orderly manner and after a few preliminary circles set off straight as a die for their various feeding grounds, each flock keeping together and taking a separate direction. It is a very prolific bird.

I found one nest with six eggs in March which were hatched and reared successfully and the bird laid four more eggs in the same nest in May.

58. Sturnia malabarica blythii. Blyth's Mynah.
A very common resident though not so common as the last bird. It breeds in barbet holes in high trees and often seems to evict the rightful owner. In the cold weather it roosts in large numbers in reed beds in company with the common Mynahs.

59. Uroloncha striata striata. White-backed Munia.
A common resident, usually occurring in considerable flocks and picking up much of its food which consists of grain and seeds on the ground. It breeds chiefly in July after the rains break and nearly always makes its nest in small trees standing by themselves right out in the open. It frequently breeds in gardens and is very tame. Both birds of a pair usually roost in the nest both before it is completed and while the eggs are being incubated.

60. Gymnoris xanthacollis xanthacollis. The Yellow-throated Sparrow.
A common resident breeding in old barbet holes in high trees. It keeps away from human habitations being decidedly shy. It has a loud chirrup very like that of the House Sparrow.

61. Passer domesticus indicus. The House Sparrow.
Ubiquitous in all towns and villages but never seen far away from them.

62. Corpodacus sp. The Rose Finch.
A somewhat uncommon winter migrant occurring in large flocks. First seen December 22, 1928.

63. Hirundo rustica gutturalis. The Eastern Swallow.
A common winter visitor. A very large number of these migrants are young birds lacking the prolonged outer tail feathers. Earliest date for Coorg, September 28, but in Mysore I saw them in large numbers on September 16. Nearly all our winter migrants arrive in Mysore at least a week before they penetrate into Coorg although it is on the same latitude.

64. Hirundo daurica. The Striated Swallow.
A fairly common resident in the dryer parts of the district. It is fearless of man but is especially prevalent round tanks in the jungle. It often nests under bridges and culverts.

65. Motacilla alba maderaspatensis. The Large Pied Wagtail.
Occurs though not in large numbers along the banks of rivers and big tanks. It is apparently resident.

66. Motacilla cinerea. The Grey Wagtail.
Our commonest winter migrant. Dates of arrival, August 28, 1927 (Nilgiris), August 31, 1928 (Coorg).

67. Dendronanthus indicus. The Forest Wagtail.
A well distributed winter migrant, but never very numerous. It keeps to shady woodlands clear of undergrowth and may be seen picking up insects under the trees though it is much more arboreal than other Wagtails. Its tail is comparatively short and is wagged from side to side not up and down. It is usually solitary or in pairs and has a ' chink, chink ' call very like a Chaffinch. Earliest record October 16.

68. Anthus richardi rufulus. The Indian Pipit.
A common resident breeding in all parts wherever this any open grass land.

69. Zosterops palpebrosa. The Indian Whiteye.
A common resident.

70. Leptocoma asiaticus. The Purple Sunbird.
Common everywhere. The winter moult only seems to affect some birds, as one sees males in breeding plumage at all seasons of the year.

71. Leptocoma zeylanicus. The Purple-rumped Sunbird.
Even commoner than the Purple Sunbird. There appears to be a great increase in numbers of this species in the breeding season at the end of the hot weather, though whether this is actually the case I do not know. It might be due to be males putting on an ' eclipse ' plumage for a few months after the autumn moult and not moulting into breeding plumage till late.

72. **Dicæum erythrorhynchus.** Tickell's Flowerpecker.
A very common resident breeding about April, when they can often be seen collecting down from the seed heads of various weeds. The nest is somewhat like a small edition of a Sunbird's but is more globular and lacks the tail of rubbish hanging below.

73. **Pitta brachyura.** The Indian Pitta.
A fairly common winter migrant. It is a solitary bird haunting dense thickets and thick shady forest where it hops about on the ground coming out in the open occasionally in the evening. It has a loud shrill call which is heard much more often than the bird is seen.

74. **Picus chlorolophus chlorogaster.** The Southern Yellow-naped Woodpecker.
Widely spread but nowhere numerous. It chiefly haunts damp swampy forest land. It has a harsh screaming cry but not nearly so loud as the Golden-backed Woodpecker. It is an early breeder. I saw one evict a Green Barbet and take possession of its nest-hole early in January and found a nest with three newly-hatched young at the end of February. This nest was in a stump not five feet from the ground, unusually low for a Woodpecker.

75. **Iyngipicus gymnopthalmus.** The Pigmy Woodpecker.
Fairly common. An active little bird resembling a nuthatch in its habits, and often going about with the mixed flocks of Tits, Nuthatches and other small birds which are commonly seen in the cold weather. It keeps exclusively to the tops of tall trees.

76. **Micropternus brachyurus.** The Rufous Woodpecker.
Fairly common. It is a great drummer and usually betrays its presence in this way, but is otherwise very silent.

77. **Brachypternus aurantius puncticollis.** The Southern Golden-backed Woodpecker.
Much the commonest woodpecker in these parts. It is a very noisy bird with its harsh scream and an energetic drummer. It is an early breeder usually hatching out its young in the first week of March.

78. **Thereiceryx zeylanicus.** The Green Barbet.
One of the very commonest birds here, its loud monotonous call dominating every other bird note except the Coppersmith, and resounding all day the whole year round. Every dead soft-wooded tree is riddled with its neat round nest-holes. It is a very early breeder starting in December. They literally swarm on certain species of wild fig when the latter are in fruit. They seem to be almost entirely frugivorous but I have seen one catch and devour a small lizard.

79. **Xantholæma hæmacephala indica.** The Indian Crimson-breasted Barbet.
As common as its larger relative and very similar in habits. They breed either in dead trees or dead branches of living trees usually high up. They will desert a hole at once even if a straw is pushed in to feel, before the eggs are laid. They apparently never breed twice in the same hole.

80. **Coracias benghalensis indica.** The South Indian Roller.
An occasional visitor in the dry season never staying long. To be seen on isolated trees in open fields or on telegraph wires.

81. **Merops orientalis orientalis.** The Common Bee-eater.
An exceedingly common species in the cold weather arriving in October and leaving at the beginning of March. It is common at all times of the year in the dry Mysore plateau 20 miles to the East and apparently breeds there. Arrived October 10, 1928. Last seen March 7, 1929.

82. **Melittophagus erythrocephalus.** The Chesnut-headed Bee-eater.
This species appears to be a passage migrant in this part of the world. It was extremely common in large flocks during June 1928 but disappeared entirely at the end of the month. A flock was seen on September 24, 1928, but since then none. They always kept very closely together and ten or twelve might be seen huddled on one branch flying out at intervals to catch an insect.

83. Ceryle rudis leucomelanura. The Indian Pied Kingfisher.
Common on the Cauvery and other big streams but not on small brooks or tanks much surrounded with trees. It never fishes from a perch but flies over the water and hovers like a Kestral and then plunges headlong, often from a very considerable height.

84. Alcedo atthis taprobana. The Ceylon Kingfisher.
Common. Most small ponds have a pair which are resident there throughout the year.

85. Halcyon smyrnensis. The White-breasted Kingfisher.
Common. It is a solitary bird and much less of a fish eater than most species. It is often seen well away from any water, though it is very fond of wet paddy fields. Its call is a loud, harsh scream usually uttered in flight.

86. Upupa epops ceylonensis. The Hoopoe.
Uncommon. May occasionally be seen in the cold weather in dry open 'maidans' picking up insects, usually solitary, but sometimes in pairs.

87. Micropus affinis affinis. The Common Indian House Swift.
Fairly common but its numbers vary greatly. One day it may be seen in large flocks and then disappear for several weeks. I do not think it breeds in the district, though I have found a breeding colony under a bridge in Mysore territory some ten miles over the border.

88. Hirundinapus gigantea indica. The Brown-necked Spinetail.
Not very common. May be seen in small parties wheeling high in the air at tremendous speed. They are magnificent fliers and few birds can be faster.

89. Collocalia unicolor unicolor. The Indian Edible Swiftlet.
The commonest swift here. It is always present in large numbers and probably breeds in caves in the higher hills.

90. Caprimulgus asiaticus. The Common Indian Nightjar.
Common wherever there are patches of open land with jungle near at hand. They have a great partiality for squatting on roads through the jungle after dark ; driving a car at night one flushes them in dozens. Their eyes show up when reflected in the headlights, as ruby specks, at a tremendous distance, up to quite two hundred yards.

91. Hierococcyx varius. The Common Hawk Cuckoo.
Uncommon. I have never heard it calling. Usually to be seen slipping furtively about in low trees in orchards and the edges of the jungle. I saw an immature cuckoo, which I believe was of this species being fed by a pair of Magpie Robins in June.

92. Eudynamis scolopaceus scolapaceus. The Indian Koel.
Only a casual visitor to the district though very common down in the Mysore plains.

93. Centropus sinensis parroti. The Southern Crow Pheasant.
Very common everywhere though most usually to be seen on the borders of swamps and thickets of lantana and brushwood.

94. Psittacula cyanocephala cyanocephala. The Western Blossom-headed Paroquet.
Extremely common and very tame. They do an enormous amount of damage in orchards and paddy fields, eating the fruit and grain. They are very early nesters, starting at the beginning of January, enlarging a natural hole in a dead tree or an old Woodpecker's hole. Their nests may always be identified by looking at the chips underneath the tree. In the case of the Paroquet they are almost cubic chunks evidently bitten off, whilst woodpeckers and barbets make long thin slivers, using their beaks chisel fashion.

95. Psittacula columboides. The Blue-winged Paroquet.
Common though not so numerous as the last species. Its cry is rather harsher than that of the Blossom-headed Paroquet but its habits are quit similar and it breeds about the same time.

96. **Coryllis indicus.** The Ceylon Loriquet.
Very common, though a quiet little bird keeping to the tree-tops and hence inconspicuous. Its call is a weak little scream. It is very tame especially when any garden fruit is ripe, robbing the trees with the utmost boldness. It is very fond of loquats.

97. **Huhua nipalensis.** The Forest Eagle-Owl.
Widely distributed though nowhere numerous. It spends the day in thick evergreen trees and is much mobbed by Drongos and Minivets if discovered. At night it may often be disturbed from stumps or rocks on road sides and is very fearless, flying only a few yards and settling again. Its cry is a deep, low moan.

98. **Pseudogyps bengalensis.** The White-backed Vulture.
The only common vulture here. A few birds may usually be seen soaring at an immense altitude, whilst if anything has died in the vicinity scores of them congregate in a very short time.

99. **Neophron percnopterus ginginianus.** The Smaller White Scavenger Vulture.
I saw one of these birds on February 26, 1929 circling round a slaughter-house in company with White-backed Vultures. This is the only time I have seen one in Coorg though they are common enough in Mysore.

100. **Ictinaetus malayensis perniger.** The Indian Black Eagle.
One of these birds visited the estate on which I live for about a week in November 1928. It was very shy and wary and spent most of its time sailing low over jungle and swamps quartering the country rather like a Harrier. It was noticeably long winged. This is the only occasion on which I have seen it.

101. **Spilornis cheela.** The Serpent Eagle.
Common, though not very numerous, each pair having a wide territory of their own. It is rather sluggish spending most of its time perched on dead trees by ponds and swamps. It apparently feeds largely on frogs. I have several times seen it settled on the ground in paddy fields, probably frog hunting, though I have never found any signs of anything on putting it up. I once saw one eating offal from a bullock which had just been slaughtered. At times it soars high in the air, often two or three together, uttering its distinctive loud, whistling cry.

102. **Polioaetus icthytaeus.** The Large Grey-headed Fishing Eagle.
The only pair I have seen haunt a small tank in the jungle on the Coorg-Mysore frontier. They have their eyrie, a huge mass of sticks, in the fork of a big jungle tree some forty feet from the ground.

103. **Haliastur indus indus.** The Brahminy Kite.
Stray birds are occasionally seen, but it is far from common.

104. **Milvus migrans govinda.** The Common Pariah Kite.
Occurs in the neighbourhood of most villages, but not in any great numbers. It does not appear to breed in the district, disappearing at the end of the hot weather.

105. **Astur badius.** The Shikra.
Widely spread but not common.

106. **Buteo** sp. The Buzzard.
A buzzard of some species is a fairly common resident in the district. It is usually to be seen in pairs, soaring high in the air, uttering a mewing whistle very like the cry of the European Buzzard. In the breeding season they go through curious aerial evolutions rather like the tumbling of a raven. The bird swoops downwards and then turning sharply flaps vertically upwards for a few feet, then rolls over and swoops headlong with closed wings for several yards, flattens out and repeats the performance, all the while uttering a sharp, short ' kit, kit, kit.' They are light coloured birds and have a peculiar crest of a few black feathers sticking vertically up from the back of the head. I saw a pair feeding a full grown young one with lizards on July 24, 1928.

107. Falco peregrinus peregrinator. The Shahin Falcon.
An occasional wanderer into the district.

108. Dendrophasa pompadora pompadora. The Pompadour Green Pigeon.
Large flocks of these birds come into the coffee estates from September to Christmas to feed on the fruit of various fig trees which are grown as shade. They spend the rest of the year in the jungle.

109. Chalcophaps indica. The Bronze-winged Dove.
A forest bird but occasionally seen in well-wooded coffee estates. Usually encountered flying low and very fast through the woods or picking up grain round cart stands on jungle roads. It is nearly always solitary.

110. Streptopelia chinensis. The Spotted Dove.
Swarms everywhere. One of our commonest birds. It is very tame and confiding. It feeds mainly on the ground on grain and various wild seeds. One which I examined, had its crop stuffed with the seeds of the Sensitive Plant (*Mimosa*).

111. Pavo cristatus. The Common Peafowl.
Common in the scrub jungle on the Mysore frontier.

112. Gallus sonnerati. The Grey Jungle Fowl.
Common everywhere even in cultivated land wherever there is sufficient cover in the form of lantana scrub. They may always be seen in large numbers soon after dawn on any road through the jungle.

113. Galloperdix spadicea. The Red Spur Fowl.
Common in the same sort of country as the Jungle fowl. It can be heard very much more frequently than it can be seen as it is very shy and seldom leaves cover.

114. Microperdix erythrorhyncha. The Painted Bush Quail.
Somewhat scarce, though one comes across a bevy of them now and then dusting in the road.

115. Lobivanellus indicus indicus. The Indian Red-wattled Lapwing.
Common around tanks and on maidans in the drier parts of the jungle, also along the banks of the Cauvery where it is open.

116. Tringa ochropus. The Green Sandpiper.
These birds may be seen in the cold weather singly or in pairs in almost every patch of marsh, in stream beds or round tanks. They never seem to go far from water and move about very little.

Each pair have their favourite spot where they may be found at any time and they seem to return to it year after year. They are early arrivals and leave very late, often lingering on into May. First seen September 30, 1928.

117. Gallinago stenura. The Pintail Snipe.
Abundant in the cold weather in suitable swamps and abandoned paddy fields. They are usually in large wisps at the beginning of the season but split up into pairs before leaving. They are peculiar birds and may throng one field one year whilst another apparently just as suitable will not hold one. The next year the positions may be reversed. Date first seen October 10, 1928. This is very late and birds were seen in Mysore three weeks earlier whilst one hears of stray individuals in August. Most have left by the end of March though a few pricked birds, which are not strong enough to migrate, linger on.

118. Amaurornis phœnicura phœnicura. The White-breasted Water-Hen.
A shy and solitary bird which may occasionally be flushed out of reed beds near ponds and along the banks of streams.

119. Ardeola grayii. The Indian Pond Heron.
Widely distributed wherever there are paddy fields, ponds or swamps.

SHELLS

OF THE TROPICAL SEAS

BY

IDA COLTHURST

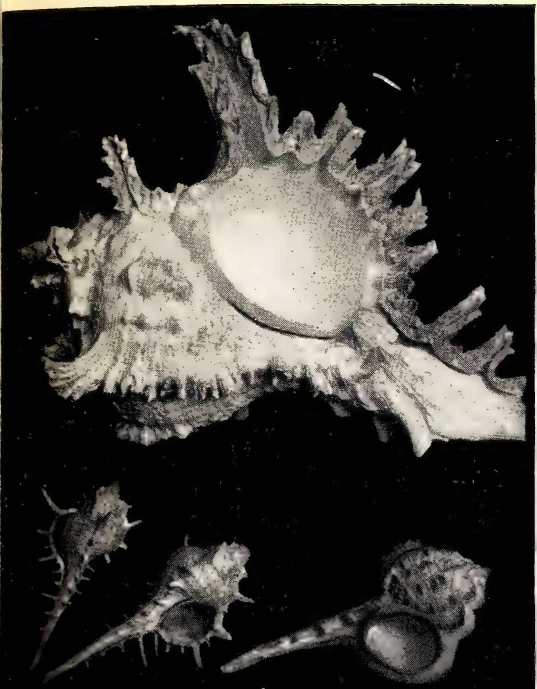
PART II

(*With 4 plates and 15 photos in the text*)

(*Continued from page 383 of this volume.*)

The *Gastropods* rank next in point of physical organization. They are stomach-walkers, creeping by means of a strong muscular foot running along the underside of their bodies. Most often they carry a shell and in all cases except one composed of one piece, a *Univalve.* The animals possess a more or less distinct head carrying from two to six paired tentacles, one of which usually bears eyes at the base ; in some however, the eyes though present are covered with a thick skin which renders them useless, while in others again there is no trace of an organ of sight. The tongue is very characteristic, long and ribbon-like and studded with teeth for rasping and tearing ; but it varies in different genera according to the food of the animal. The shells, very elegant and often beautifully sculptured, are essentially longer or shorter hollow cones, sometimes quite simple, otherwise coiled spirally to the right, some few being more rarely turned to the left; in the centre is a pillar or axis, the top is the apex, each coil is a whorl, the largest being the body whorl, and the aperture the mouth. Many close this mouth when they retire within with a trapdoor called the *operculum.* The organs of the body are asymmetrical, that is, those on either side do not correspond, a condition brought about in the course of evolution by a complicated process of torsion and flexure.

The *Strombidæ or Wing shells* (from *strombos* = a top) are among the largest gastropods (see Plate II, Fig. 4); the shells are short-spired, with an expanded lip, massive and thick, the substance being laid in several different-colored layers which is easily worked and consequently is in great request for the manufacture of Cameos; the axis being hollow and of uniform thickness, is cut into beads. The animal is very active and progresses by a series of rolls and jerks among the reefs at low water, where it dwells; these movements are effected by the alternate shortening and lengthening of its strong muscular foot. It has a powerful tooth ribbon and is an excellent sea scavenger, feeding on dead as well as living marine creatures. The eyes are large, placed on thick stalks with a distinct pupil and wonderfully colored double iris. In



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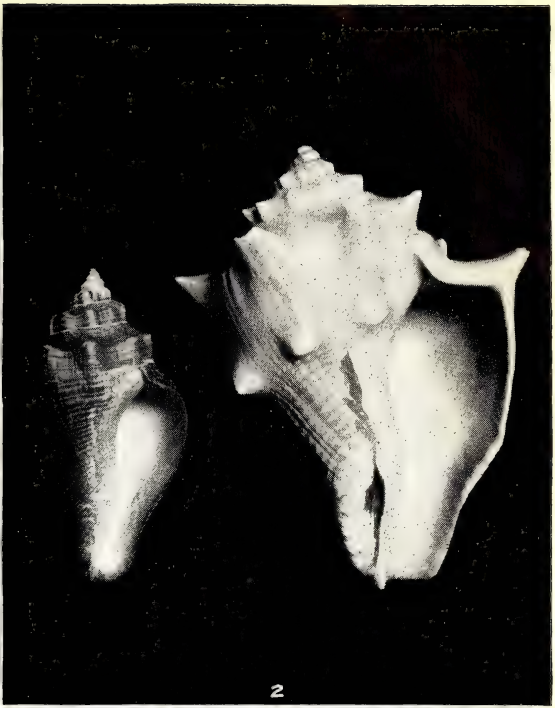

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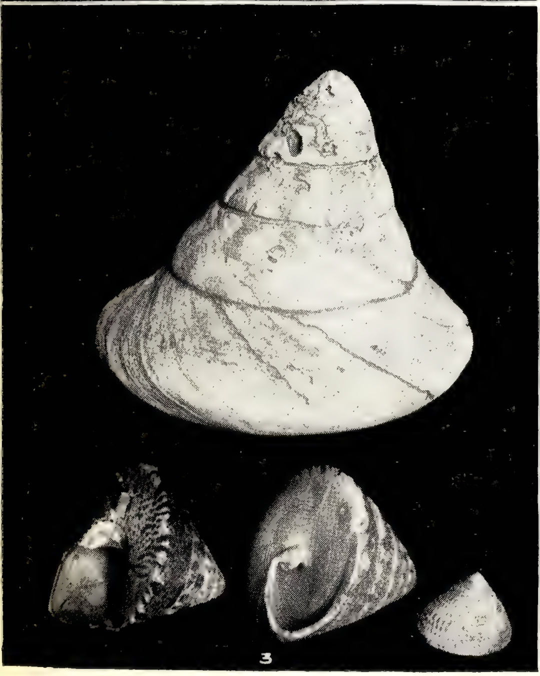

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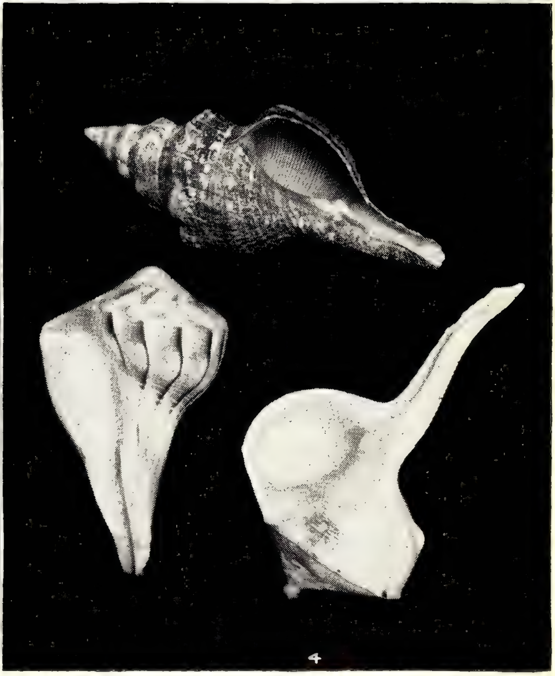
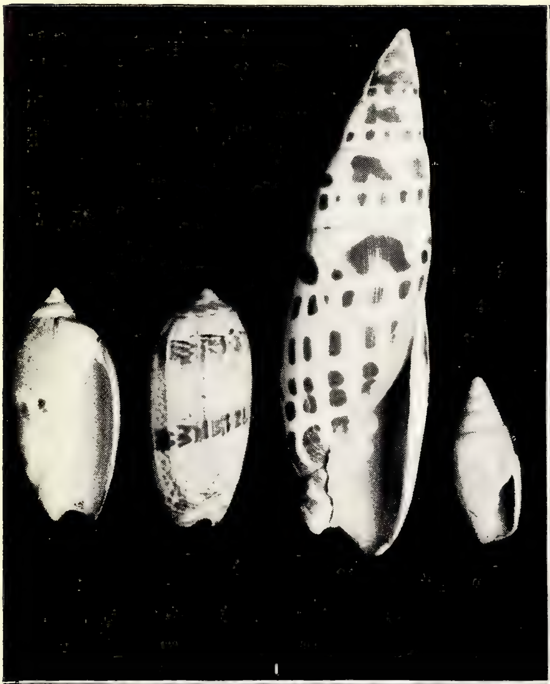


4

1. MUREX. Large, *M. endivia*. Left, The Thorny Woodcock (*M. tenuispina*); right, The Woodcock's Head (*M. haustellum*).
2. THE SPINDLE SHELLS (Fuscus). Right, *Pyrula bucephala*; left, *P. vespertilio*.
3. TROCHUS. *Trochus niloticus*.
4. THE BANDED SHELLS (Fasciolaria). Top, *F. filamentos*; right, *Tudicla spirrilus*; left, *F. perversum*.



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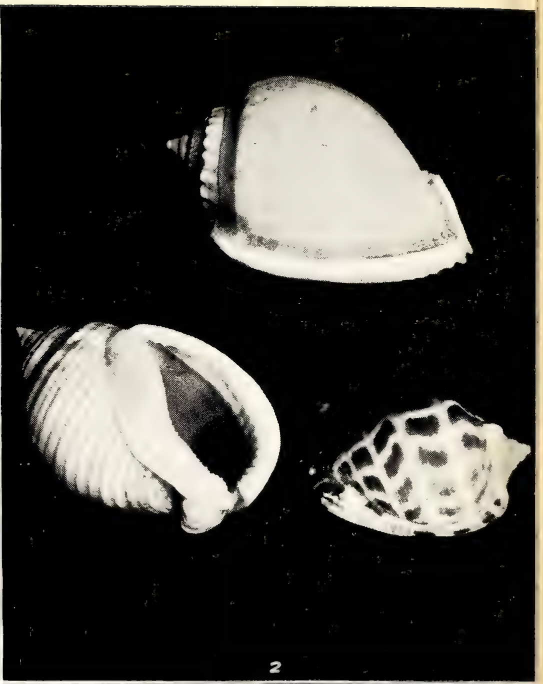

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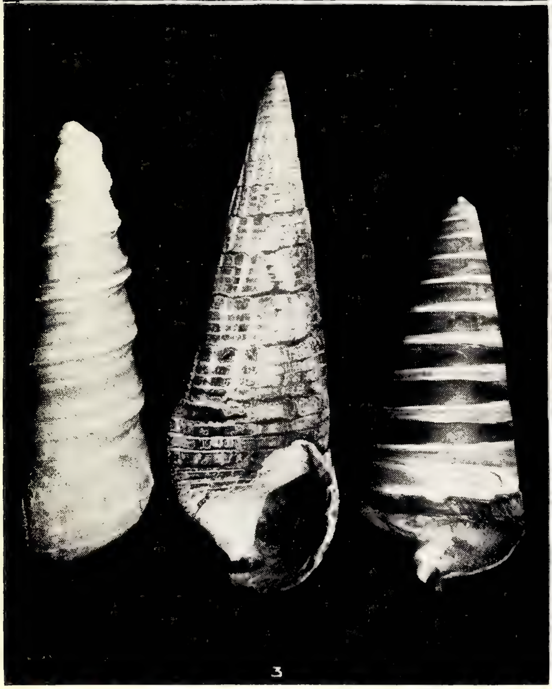

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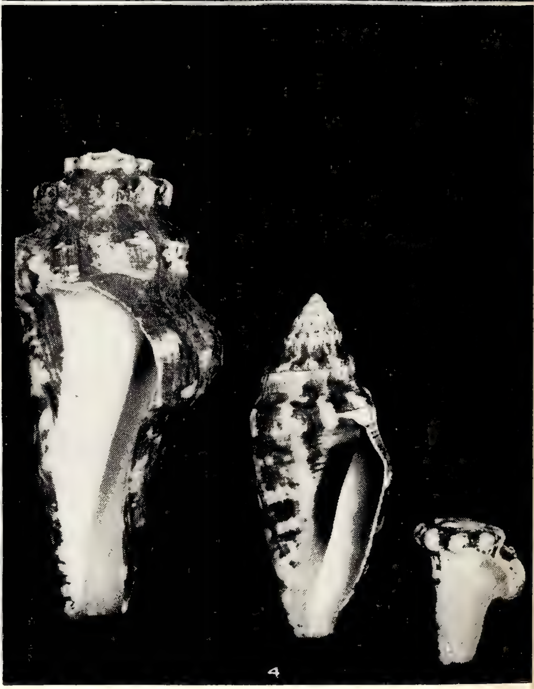

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1. Left, Olives (*O. nebulosa*); right, Mitra (*M. episcopalis* and *M. ebernus*).
2. Helmet Shells. Above, *Cassius coranulata*; below, left, *C. sulcosa*; right, *C. areola*.
3. Turret and Horn Shells. Left, *Turretella duplicata*; middle, *Potamides sulcatus*; right, *Cerithiada telescopis*.
4. Varied forms of young *Pteroceras*.

some places the *Strombidæ* are used as food, and weapons and implements are made from the shell by the Pacificis landers. They are common in the Red Sea, Indian and Pacific Oceans.

Allied is *Pteroceras*, whose flange is drawn into spines (*Pteron*=wing, *Keras*=a horn); many have such singular forms that they are known as *Scorpion* and *Spider shells* (See Pl. IV, Fig. 4) *P. chirargra* resembles an Indian lamp and *P. millepoda* has several digitations between the horns. The young shells have many varied forms, very different to the adult ones (Pl. II, fig. 4).

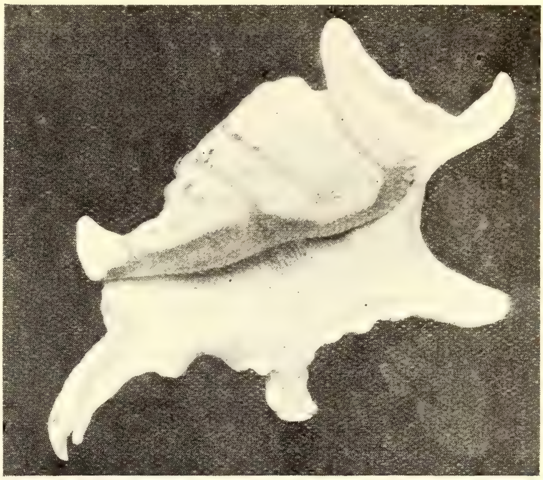


FIG. 1.
Pteroceras chirarga.

Rostellaria or the *Spindle-Stromb* has an elevated spire and prolonged canal; *Rostellaria delicatula*, common in the Bay of Bengal at the 100 fathom line is a characteristic deep sea mollusc, very thin and light, small but handsome. *R. curta*, a tapering shell 5 to 6 inches long, smooth and yellow, is common on the west coast near Bombay. Other species are found in the Red Sea and in the Indo-Pacific Ocean.

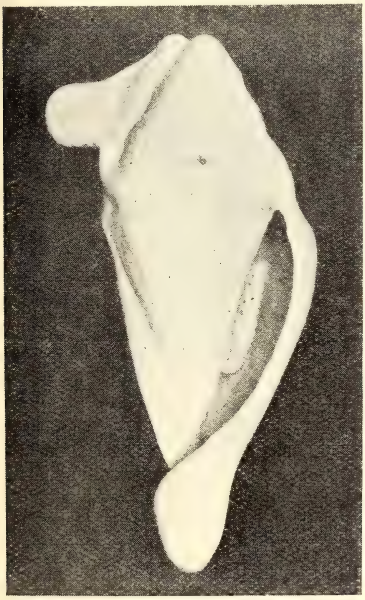


FIG. 2.
Another form of *Pteroceras.*

The *Muricidæ* or *Rock Shells* are a very numerous family and extremely varied in form, but all have three rows of spines or fringes at nearly coincidental intervals on each whorl, which become longer each year (Pl. I, Fig. 1). They have a large body-whorl, short spire and often a greatly drawn-out canal. The animal has an oval body, a mantle broken into many lobes, a formidable toothed tongue with which it bores into the shells of bivalves, and two long horns with eyes at their base. It is extremely carnivorous and not only has the power of secreting shell substance, but can dissolve any of its spiny processes when they grow inconveniently long.

M. tenuispina, *Venus' Comb*, or as it is more popularly known the *Thorny Wood Cock*, from the fancied resemblance to the head and beak of the bird, is a common shell especially on the Eastern Coast. It is ornamented with three rows of long slightly curved and slender spines. *M. haustellum*, the *Wood Cock's head* is nearly as plentiful: it has the body-whorl quite round and tuberculated and the mouth circular, pink edged and porcellaneous. *M. endivia* grows to a large size and has the spines replaced by fringed borders, pink-tinged, and denoted on the inner surface by a coral-colored line, which spreads to paint the mouth also. *M. brandaris* is very similar to *M. tenuispina* but has a short canal and a prickly surface; it yielded the famous Tyrian dye of the ancients which was obtained by crushing shell and animal together in a mortar. *M. adustus* is a dark colored shell in which the spines grow so gracefully that they have been likened to the branching of the Fir tree; it is very common at Bombay. *M. scorpio*, rather like *M. endivia*, bears a fanciful resemblance to the venomous creature whose name it bears. The *Muricidæ* are distributed all over the world and abound in our warm seas.

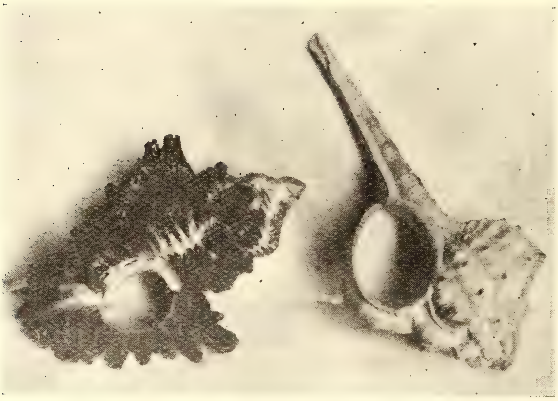


FIG. 3.
Right: *Murex haustelum*, Left: *Murex adustus*.

The genus *Fusus*, the *Spindle Shells*, also world-wide, has may members which are tropical and numbers in its species two of the largest known gastropods. The shell is spindle-shaped with a whorled spire and a canal sometimes drawn out to twice the whole length. (Pl. I, fig. 2). In certain localities all *Spindle shells* are found to be sinistral, that is coil to the left, and a few are valuable. And in many the sound of the sea seems to linger, the reverberation, apparently being retained in the lip, which when pressed to the ears simulate the rising and falling of the waves;

> 'For murmuring from within
> Were heard sonorous cadences whereby,
> To his belief the monitor expressed
> Mysterious union with its native sea.'

The empty shells suspended by a cord with the wick placed along the canal, are used as lamps by fishermen. The rest of the animal is curious, a transparent amber colored bag, smooth and glossy, within which the tiny Fusi may be seen moving about or adhering to the sides with their feet.

The *Fasciolaria* or *Banded Shells* are similar in shape but very elegant and ornamented with colored lines or tubercles arranged spirally (Pl. I, fig. 4). They also congregate sometimes in beds of sinistral members, and some grow to a great size.

Mitra, the *Mitre shells*, are a large family abundant in our seas at low water (Pl. II, fig. 1). They are long and pointed, rather thick and white, sometimes beautifully blotched with brilliant orange. Formerly when there were not so many trade facilities, many of them were valuable. *M. episcopalis*, a very abundant form in the Bay, is often washed up at Gopalpore and other East Coast places. The inmate of *Mitra* is queer-looking with a very long proboscis and when alarmed emits a disagreeably odorous purple liquid.

Turbinella or *Top Shells*, thick and solid, with a short spire, round body and a long canal intersected by 3 or 5 traverse ribs, are of great interest in India, for to this species belongs the *Chank*, *T. pyrum*, the sacred '*Mazza*', which carved and ornamented is used in Hindu, Buddhist and Jain temples. It is regarded as one of the emblems of Vishnu who is represented in drawings as holding it in one of his four hands; especially valued and valuable is the sinistral variety, *Dakshina varta*, which is believed to ensure wealth and prosperity and is sold for anything from Rs. 300. In Ceylon the *Chank* is employed to contain the holy oil for the anointment of priests and for the administration of their medicines. In Dacca, Dinajpore and other places in Bengal and Eastern Bengal, all remote from where the shells are obtained, they are manufactured into rings and ornaments and chiefly into *Sakhas* or bangles which must be owned and worn by Hindu ladies of status, and which are dearly prized. In this manufacture a cresentic saw is used to make circular sections of the round body whorl, all unevenness is removed by chiselling and rubbing on stone, and then the circles are carved and polished and sometimes inlaid with precious stones. Formerly the trade was in the hands of the Dutch, then it became a British royalty, but now it is open to the world, the shells being imported to Calcutta and distributed to the various industrial centres. The mollusc within has also a certain value (known as the *pitta*) is carefully removed and sold to *Kavirajs* who convert it into a

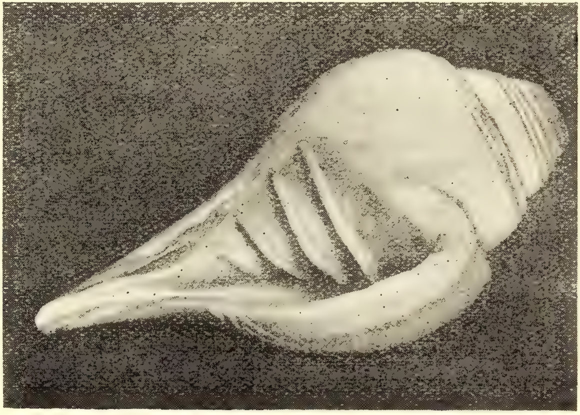


FIG. 4.
The Chank (*Turbinella napus*).

specific for spleen. All useless scraps in the manufacture of ornaments, called *Ghara*, are either constructed into beads at Murshidabad or used as gravel in temple gardens, and the dust is worked into a paste or cream for the prevention of pitting in small-pox. One of the varieties *Scolymus cornigerus* is flat-topped and ornamented with purple prickles. Others are *T. rapa* 'The Pap-boat' also used as a receptacle for sacred oil, *T. ovoides* and *T. fusus*.

The *Tritons* are oval, ventricose, few-whorled shells ornamented with many excrescences and varices, and are familiar from old mythological pictures in which the Sea-God *Neptune* is always depicted as blowing one; being so tumid, they particularly lend themselves to the use of trumpets, whose sound though loud is more monotonous and dismal than can be imagined; they are employed as musical instruments in the Indo-Pacific (Pl. III, fig. 2). In quiet seabeds they are cloaked with a soft brown velvety epidermis, and often occur in sinistral groups. *T. retusum* has a long canal and was named to express the idea of a bottle from which water could be poured in drops. The sub-species *purpura* has an abrupt spire and a very large opening, the inner lip being flattened against the whorl; it has been so called, because the occupant can be induced by pressing on the operculum to discharge a white fluid contained in a small sac by the throat, which on exposure to the air runs through the yellows and greens and finally settles into a brilliant purple, and was at one time valued as a permanent and beautiful dye in Irish manufactures, and so expensive, that a pound of wool stained by it cost £25. Another genus very similar in appearance and almost purely Indian is *Ranella*, which abounds near coral reefs the thicker and more craggy ones in shallower rocky places, the smooth species from the depths; in them are two continuous varices running down either side of the shell, demonstrating that it was constructed only half a turn between each season of rest. *Eburna spirata* (fig. 12). the Ivory shell is pale yellow with brownish blotches. It is fairly common at Bombay. *Enlima* completes a whorl and rests, thus forming a straight line on one side only. *Ranella horrida* is tinged violet and has purple tubercles.

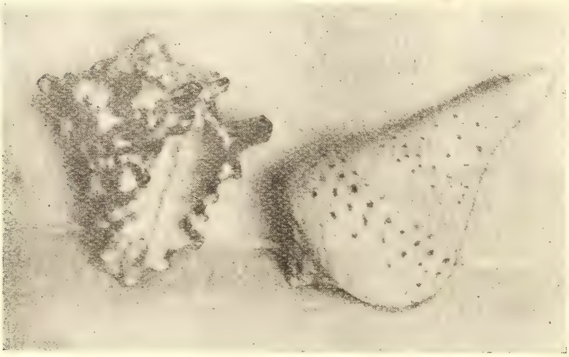


FIG. 5.
Right: *Turbinella napus*, Left: *Scolymus cornigerus*.

In India the only edible univalves are members of the Triton species; *T. elegans*, *T. bufo* with a thick shell generally encrusted with lime, and *T. carinifera* are eaten on the West Coast; the last, known as *bhikari* or beggar, as it is of poor quality and not much relished. All the members of this species are very carnivorous and are responsible for much havoc in oyster beds. The *Triton* fixes its large, thin foot on the shell of a bivalve and then with its lingual file drills a neat round hole through and proceeds to rasp out its victim. They are also sea-scavengers, eating any dead creatures they come across.

In the depth of the Laccadive Sea, which is that narrow strip of ocean lying between Malabar and the chain of coral atolls known as the Laccadive Archipelago, one of the strangest gastropods has been found: the shell is that of the *Triton* family of cold seas about 4½ inches long, and the animal has neither a toothed tongue nor even a semblance of eyes. It is burdened with the lengthy name *Pontiothauma mirabile.* The physical formation of this particular sea-basin permits of the habitation of many diverse species, for on the continental side it is shallow but by the island deep and often abysmal; another interesting point in this connection is that some of the species of marine creatures found here are the same as those inhabiting the Caribbean Sea, a part of the Atlantic.

Pyrula, signifying a little pear, is the name given to shells which are also known as *Fig Shells* from their resemblance in shape to both these fruits (Pl. IV, fig. 3). They are thin and large about 3 or 4 inches long, with an expanded lip which is particularly delicate; violet on the inner surface, white mottled with brown and yellow on the outer. The animal has a very broad foot and the shell is practically enveloped in the wide mantle lobes. A common species is *Fiscus iscoides.*

One of the largest families of tropical gastropods are the *Cones* (*Conidæ*) which are exactly like what they are supposed to represent, an inverted cone. They have a short spire, a long and narrow aperture, a sharp-edged lip and exhibit a variety of painting on the outer surface. The animal has a longish head with two tentacles carrying eyes, and the foot is wide and abruptly cut off in front. They

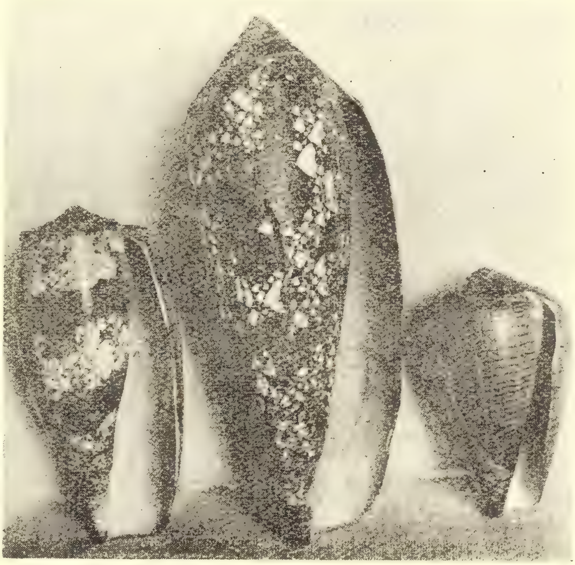


FIG. 6.

Left: *C. Geographus*, Middle: *C. textile*, Right: *C. monachus*.

are found in the fissures and holes among coral reefs, and though very leisurely in their movements they are most voracious and even fierce, sometimes turning to nip the hand when captured. They bore into the shells of other molluscs and suck out the juice. Very many species occur, some formerly very valuable; *C. gloria maris* is believed to be worth ten times its weight in gold, and the one in the British Museum was bought for £ 70. An amusing incident occurred when the second known specimen was put up to auction; it was bought in by a Frenchman who also owned the only other, and was immediately crushed to fragments by him so that he could still remain the owner of the single and unique *C. gloria maris*. *C. ammiralis*, the *Admiral shell*, has most elegant colouring, mottled brown with bands of pale fawn; *C. textile*, the *Textile Cone*, is nearly 5 inches long, a mosaic of magenta and brown and pale yellow drawn over with fine white lines. *C. pagodus* has a raised spire. *C. mutabilis* and *C. monachus* are common at Bombay, the latter brownish encircled with dark lines.

The *Volutes* (*Volutidæ*) are somewhat similar in shape but are notched in front and the columella is deeply plaited; they have very bold markings and beautiful coloring and number many hundred species. Particularly handsome is the genus *Melo*, large, inflated and in form somewhat like a melon, with either a flat spire which may be embellished with a circle of spines, or a rounded one surmounted by a round node. *Cymba* or the *Boat Shell*, so called as it is used to bail out canoes, is more globular. Both *Cymba* and *Melo* bring forth their young alive without egg shells.

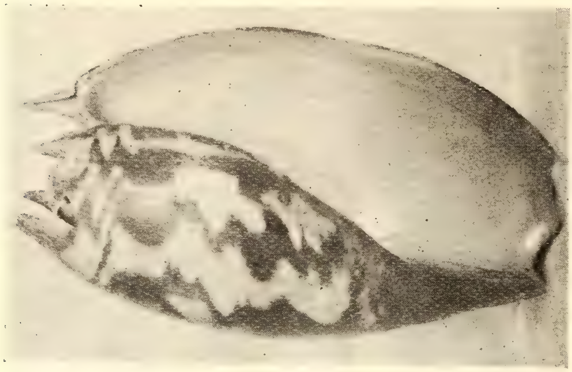
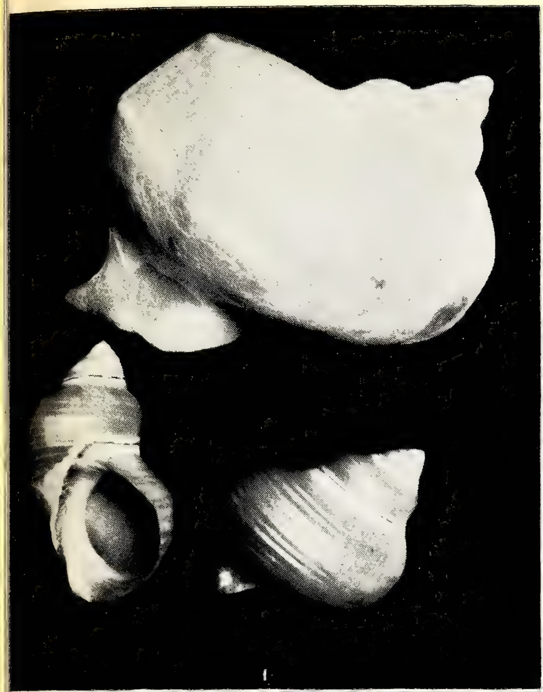


FIG. 7.
The Volute (Melo æthiopica).

The *Cowries* (*Cypræidæ*) are an enormous family numbering about 2,000 species; the cylindrical mottled shell is too familiar to be described. The tenanting animals have a large foot spreading out in all directions, a fairly big head with two tentacles at whose base the eyes occur, and a mantle whose wide lateral lobes almost envelope the shell, often fringed and adorned with bright colors. The shell thus almost concealed within the mantle is highly polished and preserved from erosion, and a distinct line can always be traced where the flaps just fail to touch and the shell is exposed.

For ages past Cowries have been used as ornaments and as charms against the evil eye, etc. The rare *Orange Cowrie* is worn as a badge of high rank among the Pacific islanders and is valuable, the one in the British Museum having been obtained for £30. The little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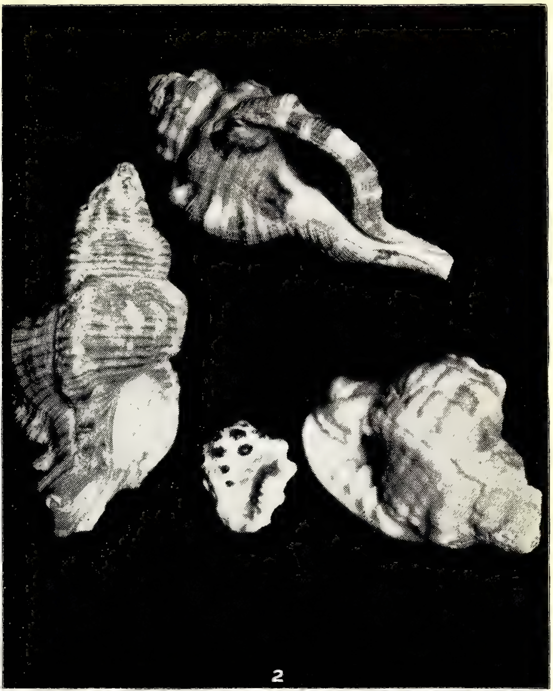
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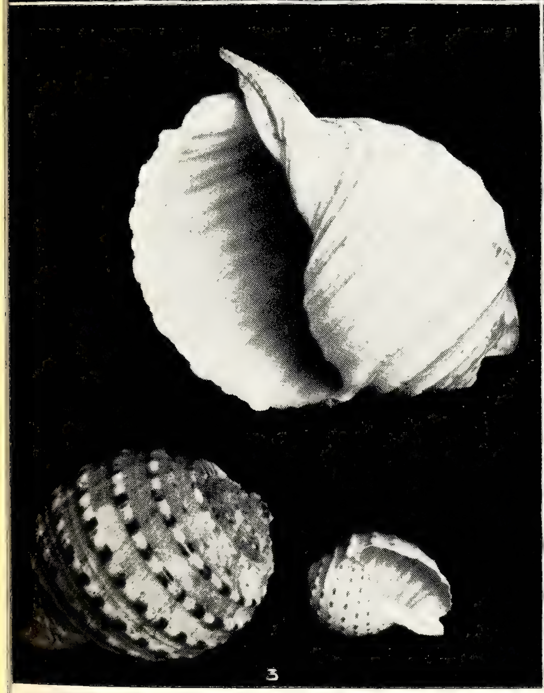
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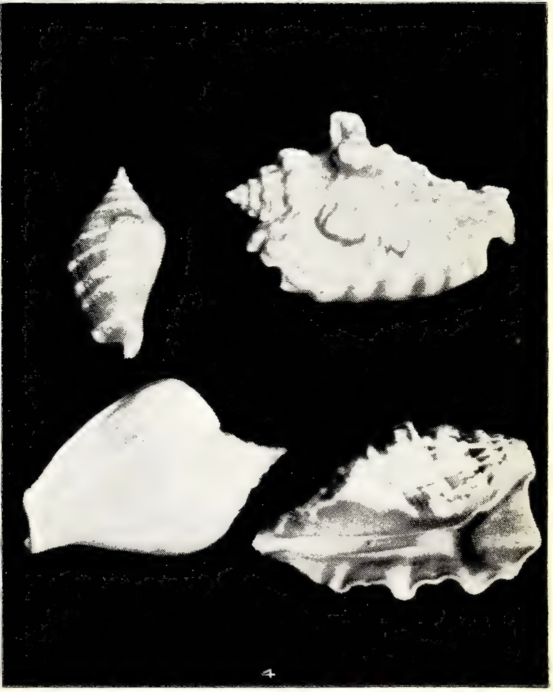
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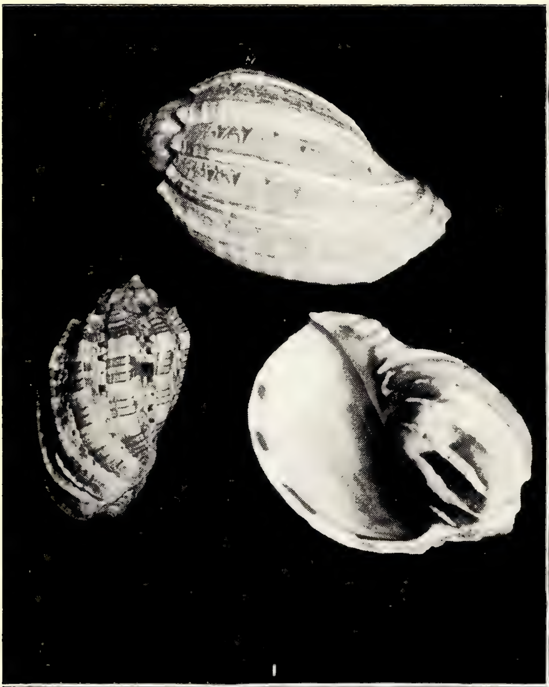
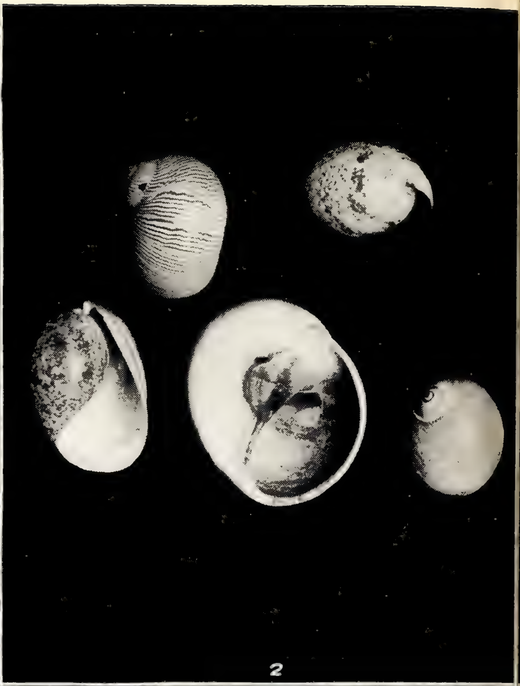
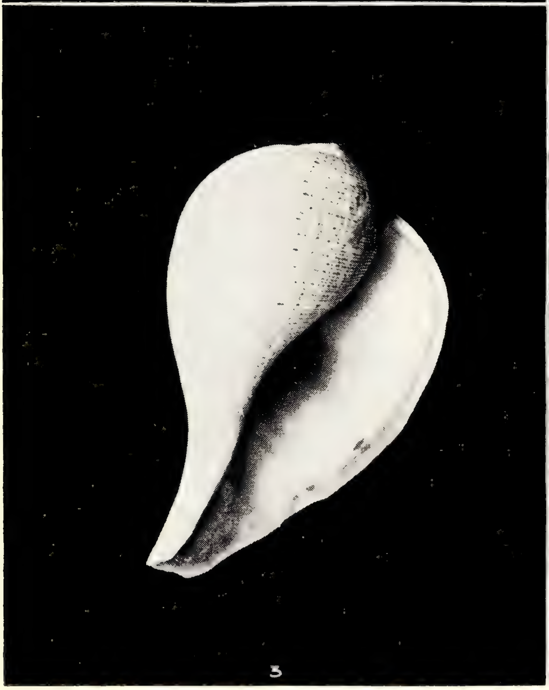
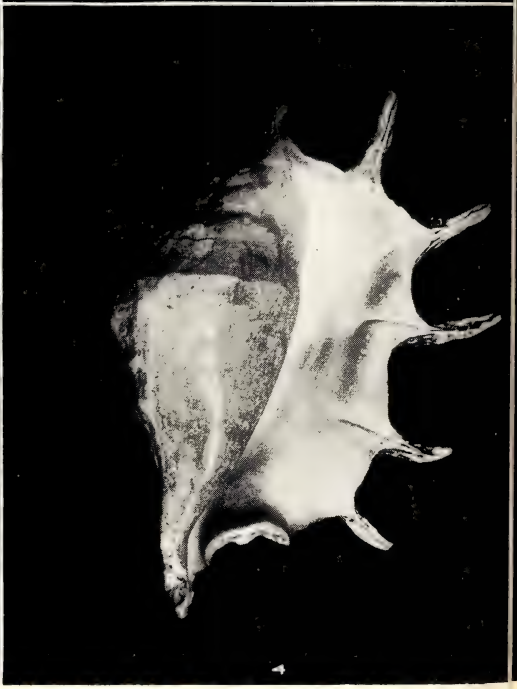
1. TURBINES. Large one, *T. marmoreus*; below, *T. imperialis*.
2. TRITONS. Top and left, *T. constrictum*; right below, *Persona anus*; little one, *R. horrida*.
3. TUN SHELLS (*Dolium maculatum*).
4. WING SHELLS (*Strombidæ*). Left top, *S. succinctus*; left below, *S. isabella*; right, *S. lentiginosus*.









1. HARP SHELLS. Large ones, *H. ventricosa*; small, *H. articularis*.
2. Left below, BUBBLE SHELLS (*Haminea*); others, SEA SNAILS (*Natica*).
3. FIG SHELL (*Fiscus fiscoides*).
4. SPIDER SHELL (*Pteroceras lambis*).

Money Cowrie, *C. moneta*, is used as currency, the value in India being about 96 to one pice; in some of the islands where Cuttle Fish are eaten, Cowries are broken and tied to a line as bait; *C. tigris* and other large varieties are employed as a support in darning stockings, and stranger still, for polishing cloth that is converted into the high Parsi hats; the cloth is imported from China and well-rubbed with a shell on which a little cocoanut oil has been applied. *Cowrie Shells* continually change their shape until they reach adult age; when young, they resemble *Vloutes* with wide lips and prominent spires; gradually so much shell substance is deposited that the spire is obliterated and at the same time the axis is absorbed either completely or until it is nothing but a thin plate. Some of the varieties are beautifully marked; *C. argus* with eyes similar to those on the tail of the Argus pheasant; *C. tigris*, black or deep brown distinct spots and blotches; *C. pantherina*, very similar but the markings running together; *C. lynx* with scattered black dots; *C. undata*, a deep glossy brown with beautiful white bands and lines; *C. histrio*, a mosaic of white and brown;

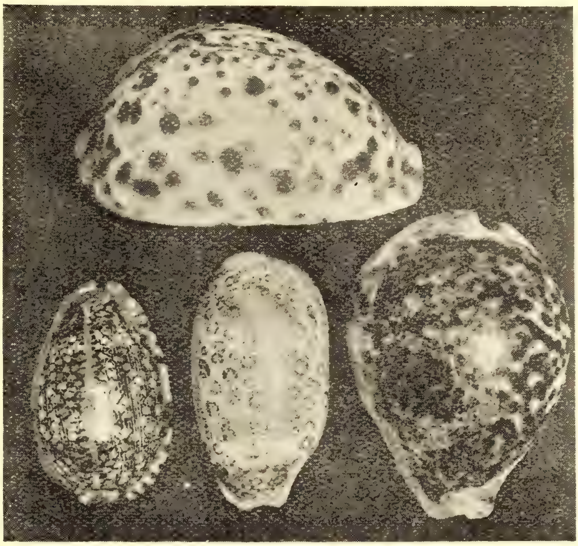


FIG. 8.

COWRIES (*Cypræidæ*). Above *C. tigris*, Below right : *C. pantherina*, Middle : *C. argue*, Left : *C. arabicula*.

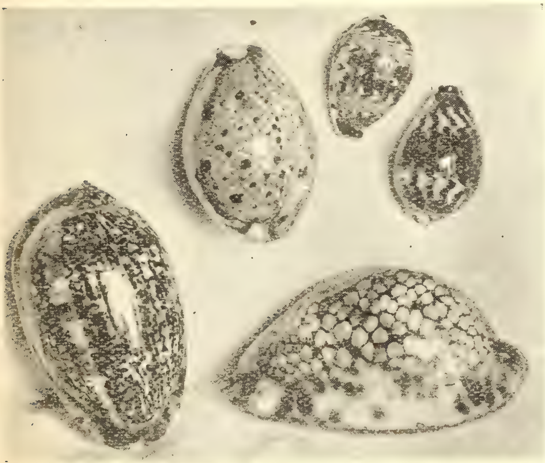


FIG. 9.

COWRIES (*Cypræidæ*). Topright : *C. undata*, Left : *C. lynx*. Below right : *C. histrio*, Left : *C. arabica*.

C. arabica, covered with queerly set brown hieroglyphics ; *C. scottii*, almost black and *C. mappa* on which the mantle marks present a deeply indented outline.

Ovulum, the *China Shell*, is similar to the Cowries, but the inner lip is smooth ; it is never ornamented but is either pure white or some delicate shade of pink, mauve or yellow. The *Weavers' Shuttle*, *O. volva*, has the aperture extended at each end. *O. spelta* very similar, is common on Bombay shores. The animal of *Ovulum* feeds on the red corals, and many of the Ovuli attend corals of similar colour.

The *Harp Shells*, (*Harpa*), have several, smooth, vertical ribs like the strings of a harp, each of which has been a periodic mouth ; the spire is short, the aperture wide, and between the ribs are delicately drawn patterns and lines (Pl. IV, fig. 1). The animal has a very large foot, anterior part of which is distinct from the posterior by deep lateral fissures which separate when the animal is irritated. It frequents the muddy coasts of Ceylon but in rather deep water.

The *Olives* (*Olividæ*) are as beautifully polished as the Cowries and have lovely colour markings in a variety of patterns ; they are cylindrical with a short spire and long narrow mouth, and are sometimes called *Rice Shells* (Pl. II, fig. 1). The animals are very active and glide about swiftly in low water or bury themselves in the sand as the tide goes out. It is one of the commonest shells on all sandy Indian shores; *O. nebulosa*, whitish-yellow marked with grey-brown zig-zags is found at Bombay.

The *Helmet Shells* (*Cassididæ*) comprise many giant gastropods, all living in shallow water near the coast. The shell is massive, always thick with an almost obliterated spire ; the inner lip is amalgamated with the body whorl and the outer one is reflexed and toothed ; the canal is sharply recurved in front (Pl. II, fig. 2). The shell-substance is of differently coloured porcellaneous strata, which lends itself admirably to cameo carving, an industry which since the 15th century has flourished in Italy. *C. rufus* yields pale salmon cameos on coral or orange ; *C. tuberosa*, white upon dark claret.

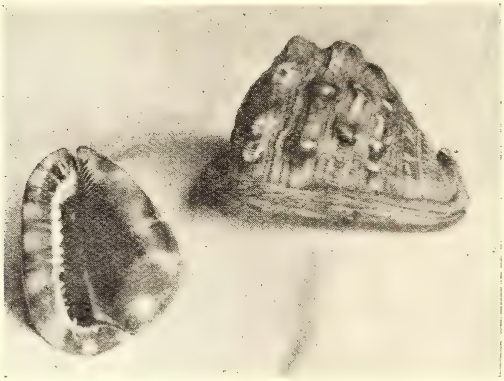


FIG. 10.
Helmet Shell (*Cassius rfus*).

Dolium or the *Tun Shell*, though belonging to the same class is very thin and large with a gaping aperture ornamented with transverse ribs (Pl. III, fig. 3). *D. maculatum* has these ridges speckled with brown, and is fairly common on the shores of the Bay. *Tun* in Burmese means light.

In the *Turbines*, which are mostly littoral and all vegetable feeders, the shell is convoluted, inflated and brilliantly nacreous, but frequently covered with a thick fibrous coating (Pl. III, Fig. 1). The head and sides of the animal are fringed and lobed; it generally lives near the shore, but *T. indicus* is a deep-sea dweller and hospitably accommodates on its shell a barnacle and a sponge. *T. marmoreus* is a large pearly shell which jewellers and lapidaries employ in their art; in Siam and Japan it is introduced into the ornamentation of screens, boxes, etc. and is employed in the famous *aqua-marine* work of Jeypore. *T. imperialis* is lined spirally; *Margarita umbilicalis* (Fig. 12) is globular with a deep, central, round indentation; *T. elegans* brown,

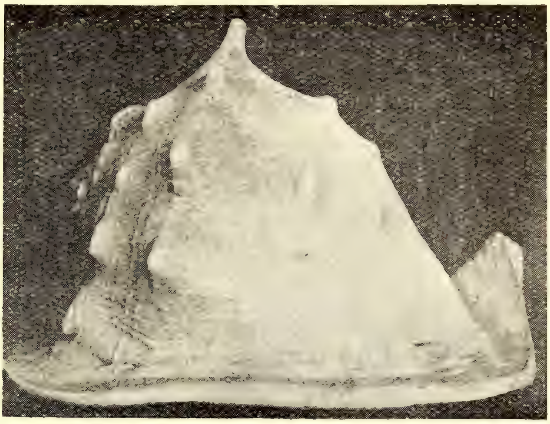


FIG. 11.
Helmet Shell (*Cassius tuberosa*).

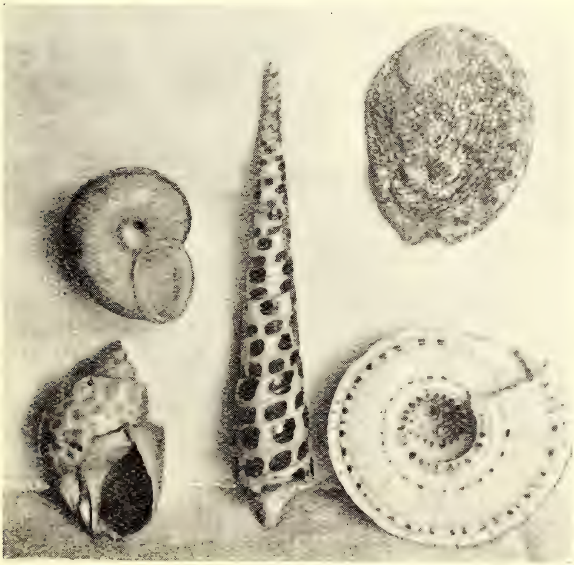


FIG. 12.
Above right: Earshall (*Haliotis striata*). Below right: Staircase Shell (*solarium*) Middle: Augur Shell (*Terebra tigrina*) Above left: (*Margarita umbilicalis*). Below left: Ivory Shell (*Ebruna spirata*).

with green and yellow blotches is ridged spirally, and very common on Bombay shores.

In the allied genus *Trochus* the shape of the shells is pyramidal with a nearly flat base ; the outer covering has broad red or maroon stripes running downwards (Pl. I, Fig. 3) ; when alive the intervening colour is green or yellow—turning to white when dead. *T. depictus* is greyish-yellow with black markings, very plentiful on the West Coast. The tiny highly coloured shells of *Rotella vestiaria*, the *Rosary or Button shells* are common among the shingle of a sandy beach ; they are no larger than a two-anna bit, quite flat, often pink and beautifully striated.

The *Ear Shell* (*Haliotis*) has a dull outer surface often incrusted with corallines, and an inner one brilliantly iridescent, with the growth of each year marked by a fine ridge sweeping from the flattened spire to the margin ; each line is perforated by a single hole near its extremity which are successively closed. The inmates are sometimes eaten, and because of its wonderful mother-of-pearl the shell is converted into buttons and ornaments and is used chiefly for inlaying delicate *papier-maché* and wood work.

The *Ianthinidæ* or *Purple Sea Snails* are gregarious and drift about in small companies. At certain seasons they send out a membranous float full of air cells, to which the egg sacs are attached beneath. These shells, very fragile toning from violet to purple, come up in the nets of fishermen all round our coasts.

The *Sea-Snails* (*Natica*) have globular, shining shells many of which are of great beauty and wonderful markings which are never lost, not even in fossil specimens. The aperture is large semilunar and unbilicated *i.e.* the axis is hollow (Pl. IV, Fig. 2). The animal is quite blind and buries itself deep in the sand by low water mark, a defect however which does not interfere with its extreme voracity ; it has an extension of the forepart of the foot that projects over the head when crawling and probably protects it. *Naticas* prey on *Bivalves* and in turn are devoured by Star Fishes, etc., *N. didyma* attains a good size ; it is fawn tinged with plumbago and is easily recognized by a deep brown shield

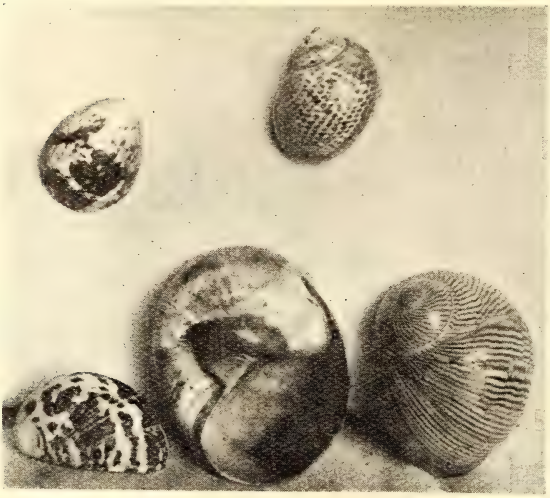


Fig. 13.

Left above and below : *Nerita oryzaru*. Middle : *Natica didyma*. Right, below : *N. lineata* ; above : *N. maculosa*.

nearly closing the umbilicus. *N. lineata* has irregular closely drawn purple-brown lines running down the shell slantingly ; *N. maculosa*, smaller with dark red spots and markings, and *N. rufa* a yellowish shell banded with white, are found on all our coasts.

The *Staircase Shell* (*Solarium*) has been thus named because the spiral edges of the whorls do actually ascend like a winding staircase ; it is orbicular and rather depressed, with a square aperture (Fig. 12).

The *Ladder Shell* (*Scalaria*) is pure white or pale fawn and transparent, traversed in its length with ribs. At one time it was considered invaluable, but with greater facilities afforded to trade, all such shells have lost in money worth. It is found only in Indian and China Seas.

The *Indian Phorous* or *Carrier and Grotto Shell* is very curious ; it is dull yellow-brown in colour and in its anxiety to attempt a camouflage or to fortify its very thin shell it sticks itself over with fragments of stone or smaller shells, each variety exhibiting an individual taste in choice of materials ; those that employ stone and coral are known as mineralogists, those showing a preference for shells, conchologists. They dispose of their acquisitions along the spiral line of their growth and in such a manner as not to interfere with their own freedom of movement. One species *Xenophora pallidula* is very common in the Andaman sea, and all inhabit deep-water.

The *Pleurotoma* are most frequently thus acquired by the Phorus ; they are a vast family and 22 per cent. of Indian deep sea gastropods belong to the species ; they are turreted or fusiform with an elevated spire and an oval aperture with the outer lip notched in front, which has gained them their name (*pleura*=the side and *tome*=a notch); they include some of the most valuable shells. Sometimes the animal is blind. *P. javana* is fusiform ; *P. congener* was found in the Bay of Bengal and first described in 1894. On its fragile outer lip it exhibits singular prominent trumpet-like expansions of two main threads of the convexity as they approach the aperture, which do not break the lip margin and are quite shut off from the interior. The *Pleurotoma* are often annexed by the *Indian Phorus* for adorning their shells, and a little *Pleurotoma*, found near Cape Comorin, is always encrusted with a particular species of Sea-Anemone.

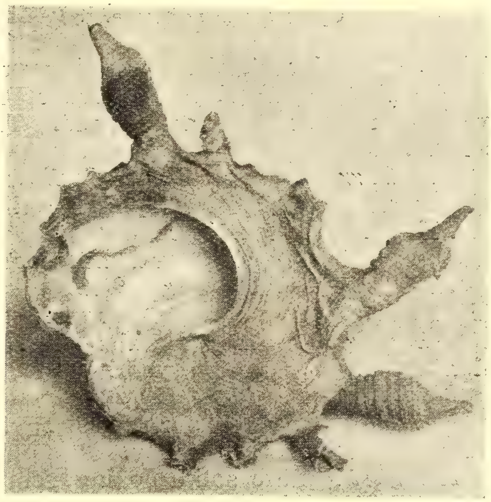


FIG. 14.

Base of the Carrier Shell (*Xenophora pallidula*) with *Plurostoma* annexed.

The *Augur Shells* (*Terebra*) are long and pointed, splashed and dotted with deep brown. *T. tigrina* is fairly common (Fig. 12).

The *Bullidæ* or *Bubble Shells* are delicate and oval with sunk spires and very wide apertures, practically internal shells for the mantle lobes almost envelope them (Pl. IV, fig. 2). The *Bullidæ* live in the sand at a considerable depth, in low water. *Haminea galba*, transparent white or yellow, is often washed ashore at and below Bombay.

The *Umbrella Shell* is an irregular placque, nearly flat and somewhat like a Burmese parasol; on the outer surface appears just the hint of an apex, inside it is rough and striated. The inmate is large and round and covered with tubercles.

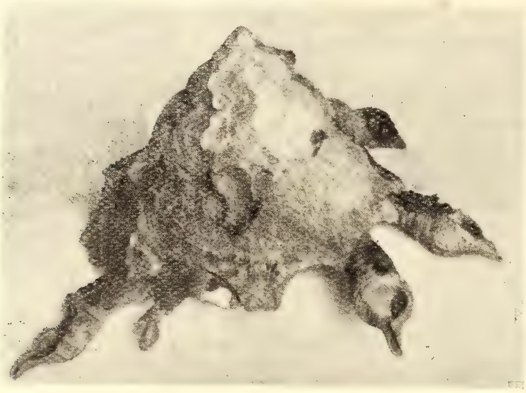


FIG. 15.
Upper surface of same.

The *Tooth Shells* (*Dentalidæ*) are cylindrical, as long as 3 inches, white, curved and open at each end. They are very common on all shores.

The *Turretellidæ* or *Turret Shells*, as their name implies are elongated, many whorled, spirally striated and grow 4 to 5 inches (Pl. II, fig. 3). *T. duplicata*, a massive white shell with two parallel ridges running spirally round each whorl, is fairly common.

The *Cerithiadæ* or *Horn Shells* are also turreted and whorled (Pl. II, fig. 3); some love to live where there are muddy stones, and two *C. morus*, a small blackish shell and *Potamides fluviatilis*, a slender shell with each whorl beaded, are very frequent on the Bombay shore, *C. telescopium*, boldly banded in maroon and white and *P. sulcatus* a deep purple-brown, each whorl showing 3 to 4 lines, are common in the Bay.

The *Neritidæ* are solid looking, semi-oval shells, flattish with a large mouth, they have been likened to D in shape. They are white, patched and streaked with black or a deep purple. The animal lives near the shore; it has a broad head and very long eye-stalks, and absorbs the internal surface of the shell to permit of room for its increasing body.

(*To be continued.*)

SCIENTIFIC RESULTS FROM THE MAMMAL SURVEY
No. XLIX

A NEW FLYING SQUIRREL FROM NEPAL

BY

HELEN M. LINDSAY, M.A., B.SC.

(*By kind permission of the Trustees of the British Museum*)

In April 1923 Mr. N. A. Baptista collected 8 specimens of a species of flying squirrel which have been listed in Report No. 37A as *Petaurista caniceps*, Gray. Further detailed examination of these creatures shows that they do not belong to that genus but that they are representative of a group of more ancient affinities than the *Petaurista* family and that they form the connecting link between the *Trogopterus* family of China on the East and the *Eoglaucomys* of Kashmir on the West. I have named these squirrels *Sciuropterus gorkhali.*

There has been great confusion in the nomenclature of the flying squirrels from this area. But careful investigation of the old literature and such plates as are available shows that Hodgson in 1842 described and pictured in his 'Drawings of Mammalia' No. 122 a small flying squirrel which he called *Sciuropterus senex* and that later in 1847 he also pictured a larger creature with distinct interfemoral membrane to which he applied the same name. Meantime Blyth in *J.A.S.B.* xiii. (1844) p. 67 takes it for granted from Hodgson's picture No. 122 that this is a specimen of *Petaurista caniceps* of Gray, though by no stretch of the imagination could he make the description of that species (which he quotes from the *A.M.N.H.* for December, 1842, pp. 262, 263) fit the animal there portrayed. Thus between Hodgson and Blyth lies the mistake in not recognizing two distinct genera amongst these flying squirrels. Later writers have followed these workers and only now that a series of specimens has become available has it been possible to decide that two genera do exist and are definitely distinct from each other.

In the British Museum collection there are a few old specimens which are true *Petaurista caniceps*, Gray, and are so labelled. These agree in each detail with the descriptions of Gray and Blyth and with the plate of Hodgson marked '*Sciuropterus senex*, Darjeeling, September, 20, 1847—India House, November, 1852, No. 28.' The type No. is 79. 11. 21. 531. a skin without a tail. No. 45. 1. 8.

242 is labelled 'Type of *Sciuropterus senex* Hodgs,' and agrees exactly with the above-mentioned picture. Other specimens also sent by Hodgson are No. 53. 8. 16. 9. and No. 53. 8. 16. 10 (a very immature specimen). These all came from Nepal but not at high altitudes as Hodgson notes.

Baptista's specimens were all collected at 12,000 feet at Gorkha, 84° 50′ E. long. 28° N. lat. This district is the area which, as Mr. Hinton noted in Report No. 37, shows the change in the character of the fauna, 'the Oriental forms disappearing and being replaced by Palæarctic types'. Mr. Thomas gives the range of *Sciuropterus* as the Palæarctic Region from Scandinavia to Japan in *A.M.N.H.* Ser. 8, vol. i, January 1908. Thus these specimens are representatives of this genus 'the little modified remnants of a very old and once widely spread group', as Dr. C. Forsyth Major notes in *P.Z.S.* 1893, in his paper on 'Some Miocene Squirrels.'

SCIUROPTERUS GORKHALI sp. nov.

The Skin

These squirrels are clothed in soft thick fur like that of *Eoglaucomys fimbriatus* in texture and, like that species, having the basal ¾ths of the dorsal hair dark ashy. Above this ashy portion comes a band of fawn colour, then one of brown abutting on the yellow coloured tip. The effect of this dorsal fur is of a dark ground-work with golden lights. Some of the hairs have black tips beyond the yellow. The parachute above is clothed with hairs dark slaty at the base passing into brilliant orange, whilst below, it is orange with a grey edge which at the joint of the forearm has a whitish tip. The size of the lateral parachute is small compared with that of the *Petaurista* family and there is 'either no interfemoral membrane at all or what there is consists merely of a slight expansion of the skin behind the knee, attached externally to the *tendon achillis* about halfway down and internally to the hinder side of the hips and never involving any portion of the tail' as noted by Mr. Oldfield Thomas in *P.Z.S*, 1886, p. 60 in his distinction between the two genera of *Pteromys* and *Sciuropterus*. The belly is ochraceous white strongly tinged with orange and has a greyish strip ventrally in the median line. Underneath the chin is a pure white patch with a narrow line of dark brown above it just at the mouth. The cheeks are clear grey, also the patch above the nose, but the head has a brownish tinge on the grey ground-work which passes on the nape into the dark coloration of the back. Under each eye is a spot of red which colour extends also in a thin line round the orbit. There is a large spot of brilliant orange behind each ear and that colour extends halfway up the thinly clad ear which is edged with dark brown. The whiskers are black and long but not bushy, only eleven hairs or so on each side. There are no eartufts as in *Belomys*. Specimen No. 917 has a group of three or four long black stiff hairs projecting just above the inner corner of the orbit, in the same way as shown in Hodgson's picture No. 122, but none of the other skins shows this. There are no long interspersed black hairs on the head such as Gray notes for his species of *P. caniceps* in *A.M.N.H.*, vol. x, p. 262 (1842). The feet are brilliant orange like the upper side of the parachute, and have claws strong and sharply curved. The hindfoot is large in comparison with the length of the head and body, averaging 62·6 mm. The metatarsal pad is elongate in shape, distant from the toepads as in *Eoglaucomys.* The fur edging to the pad is light brown, but it does not extend so far across the sole of the foot as in *Trogopterus* but considerably further than in *Eoglaucomys.* The tail is larger than the head and body and is distichous, quite distinct from the round tail of *Petaurista.* Its hair is ashy at the base passing into a broad band of reddish-fawn, then a narrow band of black ending in an orange tip. The tip of the tail is entirely black as in *Eoglaucomys* but it does not taper to a point as in that species. The average sizes of 6 specimens are H. & B. 329, Tail 354, H. F. 62·6, Ear 43.

The Skull

Only four skulls are available for measurement. Their average gives greatest length 64, zygom. breadth 40·5 basilar length 50·5, nasals 20, palatilar length 30. The dentition agrees with the description given by Mr. Oldfield Thomas in his paper 'The Genera and Subgenera of the *Sciuropterus* group' in *A.M.N.H.*, Ser. 8, vol. i, January 1908. The muzzle is narrow with parallel sides which are nearly at right angles to the spring of the zygomatic arch. P_4 is a little larger than m^1 while the molar ridges are well developed and p_3 is visible externally. Cuvier in Mem. du Mus. d' Hist. Nat. x. pp. 126–28 with pl. x, figs. 5 and 6 of 1823 distinguishes clearly between the skull of *Sciuropterus* and that of *Petaurista* (Pteromys). He says that the *Sciuropterus* has 'a head which seen in profile has all the anterior part up to the middle of the frontals on a straight line. The head is remarkable for the proportion of its frontals which has breadth to length as 1 is to 2. The cerebral capacity is $\frac{3}{5}$ths length of the skull'. *Petaurista* on the other hand has the posterior part of the nasals slightly arched and frontals strongly depressed in the middle. The posterior parts of the head do not begin to curve until the middle of the parietals. The breadth of frontals is to the length as 2 is to 3. The parietals are slightly convex and the cerebral capacity equals $\frac{1}{2}$ the length of head.

Another point of difference between these two genera, brought out by examination of the series of skulls available in the National Collection but not hitherto noted, is the shape of the anterior nares. In *Petaurista* this has a squat shape since the proportion of its transverse diameter to the perpendicular diameter is as 10 to 6. In *Sciuropterus gorkhali* this proportion is 8 to 7 which gives a more quadrate opening.

This is constant throughout these groups.

The bullæ of *Sciuropterus gorkhali* have a much more constricted appearance laterally than those of *Petaurista* and show three segments of their wall very plainly. There is also a difference in the narrowest part of the frontal bone at the postorbital process, *Petaurista* there shows a sharp angle like that of *Eoglaucomys* whilst *Sciuropterus gorkhali* has an oblong incision more like that of *Trogopterus*. The incisive index taken by the method described in *A.M.N.H.*, vol. iv, 1919 gives 60° for *Sciuropterus gorkhali* and 65° for *Petaurista*.

The skins of the specimens marked *Petaurista caniceps* in the National Collection have been carefully examined for purposes of comparison. The type specimen No. 79. 11. 21. 531 labelled 'Hodgson Nepal' has no tail but the interfemoral membrane and broad parachute together with the texture of the fur mark it as a *Petaurista*.

No. 53. 8. 16. 10 similarly labelled is a very young specimen which shows most plainly the broad parachute and interfemoral membrane. No. 53. 8. 16. 9 also young is a very dark skin with a broad membrane. Three large skins similar in size and fur are No. 45. 1. 8. 242 (which according to its label is the type of Hodgson's *Sciuropterus senex* and agreeing with his picture pl. No. 28 of India House, 1852) and two from Mandelli's collection Nos. 91. 10. 7. 60 and 91. 10. 7. 61. These three all agree in the large parachute, interfemoral membrane, ears broader than in *Sciuropterus gorkhali*, the colour of the head being not such a clear grey as in that group, whilst the proportions are altogether larger and heavier. The claws of *Petaurista* are not so curved and sharp as in *Sciuropterus gorkhali*. Gray in *A.M.N.H.*, vol. x, p. 262 of 1842 thus describes *Petaurista* (*Pteromys*) *caniceps* :—'Blackish brown varied with red bay ; hairs long, dark blackish with red bay tip ; outside of legs redder, beneath reddish yellow ; throat white ; chin black : a small lunate red spot on the upper edge (of each eye), and roundish spot near the base of the ears bright red ; tail flattish, black with some reddish tipped hairs fewer near the end. Head and Body 9 ins. : tail, 8½ ins.—India, Dargellan'—These above specimens agree with this description.

In the volume of Hodgson's 'Drawings of Mammalia' is No. 122 (so badly reproduced in *J.A S.B.*, No. 13, p. 67 and there called *Sciuropterus senex*) which is undoubtedly a specimen of what I have named *Sciuropterus gorkhali* and differing just as much from the picture No. 28 of the large creature also called *Sciuropterus senex* as do the skins from Gorkha differ from that of No. 45. 1. 8. 242. Since there has been confusion attached to the specific name of *senex* it is much better to give an entirely new name to this fine series of specimens.

The National Collection has in addition to those specimens already described other two groups of Flying Squirrels with grey heads and a red spot at the base of the ears. These are *Petaurista xanthotis*, three specimens from N. W. Yunnan, and *Petaurista clarkei* from the Mekong Valley, Yunnan. The latter set comes closest to *Sciuropterus gorkhali* in character of skin coloration but is altogether a greyer creature than the Nepal squirrel. The skull is typical *Petaurista*.

A comparative table of measurements of the specimens examined brings out the differences clearly.

Specimen	Head and Body	Tail	H.F.	Ear	Skull	Greatest length	Basilar length	Zygomatic breadth	Nasals	Palatilar length	Interorbital space	Remarks.
Sciuropterus gorkhali.												
No. 915 ♂ ...	330	350	64	42		64	49	41	20	29	12	incisive index. 60°
,, 916 ♀ ...	330	350	62	43		No skull						
,, 917 ♂ ..	330	345	63	44		No skull						
,, 920 ♂ ...	340	350	62	42		64	51	40	20	30	13	Type.
,, 928 ♀ ...	315	360	62	46		65	51	40	20	30	13	
,, 933 ♂ ...	330	370	63	42		63	50	40	20	30	12·5	
Average ...	329	354	62·6	43		64	50 2	40·2	20	30	12·6	
Petaurista caniceps.												Incisive index 65°
79. 11. 21. 531.	310	...	60	38		broken			19	28	14	Type.
53. 8. 16. 9 ...	330	360	68	35		67	52	42	19	30	14	Young.
53. 8. 16. 10 ...	175	135	40			no skull						Very young.
45. 1. 8. 242 ...	370	365	65	39		67	broken	43	20	30	14	Type of Hodgson's *Sc. senex*.
91. 10. 7. 60 ...	410	414	66	43		skull broken						
91. 10. 7. 61 ...	390	broken	68	35		no skull						
Average ...	362	380	65·4	38		67	52	42·5	19·3	29·3	14	
Petaurista xanthotis.												
No. 2775 ♂ ...	363	330	65	43		no skull						incisive index. 65°
,, 2793 ♀ ...	353	340	63	50		68	54	45	21	31	13	
,, 2794 ♂ ...	430	345	68	50		68	53	47	21	31	14	
Average ...	382	338·3	65 3	47·6		66	53·5	46	21	31	13.5	
Petaurista clarkei.												
22. 9. 1. 40 ♂	315	382	60	49		64	50	41	17	30	13	incisive index. 65°.
22. 9. 1. 44 ♂	320	370	65	50		65	51	41	17	30	13	Type.
22. 9. 1. 45 ♀	330	352	67	50		66	broken	42	18	30	broken	
Average ...	321·6	368	64	49·6		65	50·5	41·3	17·3	30	13	

FLOWERLESS PLANTS

BY

M. ROBINSON, B.A. (T.C.D.), NAT. SCI. TRIP. CAM.

PART I

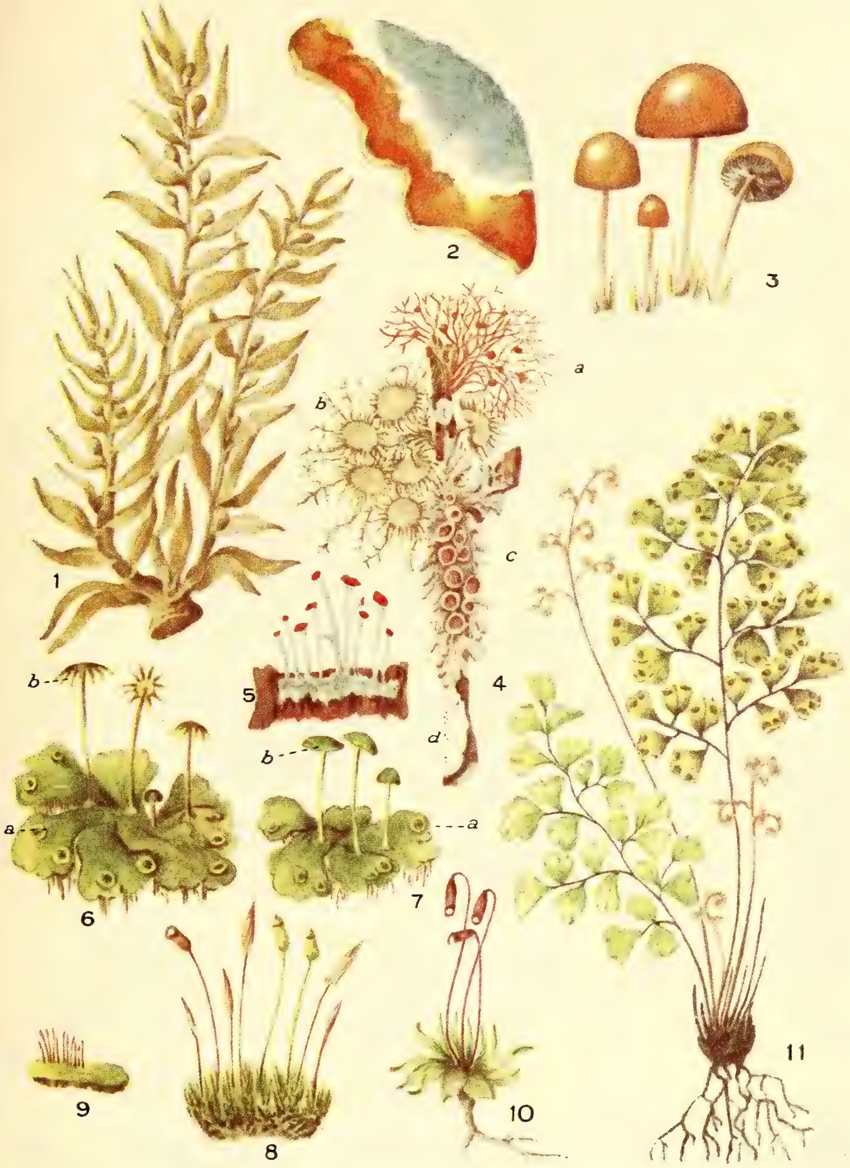
(*With one coloured and two black and white plates.*)

The science of Botany which deals with the study of plant life in all its aspects, is one which appeals in some way or another to everyone. The universal distribution of plants, and their easy cultivation, render them a source of perpetual pleasure and interest; and the economic uses of plants which provide food, clothing, oil, dyes and many other commercial products are too well known to need more than a passing mention.

There is however a large division of the plant kingdom which is almost unknown to many people, probably on account of its lack of economic importance in providing any of the useful commodities usually derived from plants. This division includes all the plants known popularly as flowerless plants; and contains several well-defined and easily recognized groups, any one of which offers a vast field for study, and a most interesting subject for the collector. These groups include the Algæ—both fresh water forms and the sea-weeds, the Fungi, Lichens, Liverworts and Mosses, Ferns and the Selaginellas.

In the two highest groups, the mosses and ferns are known to everyone: the grace and beauty of ferns, and their great variety, render them objects of interest and delight both to the gardener and the collector. The seaweeds among the algæ are familiar to us all from childhood's days, and most of us are aware of the lichens encrusting old gnarled tree trunks or exposed rocks—without perhaps knowing anything of their infinite variety, and their peculiar and interesting structure and mode of growth. The fungi provide us with edible mushrooms and poisonous though beautiful toadstools, and include the moulds that grow on all leather goods and other articles during the monsoon months, and attack all kinds of decaying vegetation, causing disease and death to many of the higher plants.

These flowerless plants are called Cryptogams: the name having been given them by Linnæus, the celebrated Swedish botanist, who was the first to introduce a natural system of classification of plants based on their methods of reproduction. He divided the plant kingdom into two main divisions. First, the higher plants which he called 'Phanerogams,' a word which means literally 'visible marriage' because they possessed flowers from which the development of fruit and seed could readily be seen; and secondly, the



SOME TYPES OF FLOWERLESS PLANTS.

1. An Alga, one of the brown seaweeds.
2. A Fungus, one of the mould fungi on a piece of orange.
3. A Fungus. Fructifications of one of the larger fungi.
4. A twig bearing four different Lichens with disc or cup-shaped fructifications, a, b, c, d.
5. A Lichen with stalked fructifications.
6. A Liverwort with cupules (a) and female sporophores (b).
7. The same Liverwort with cupules (a) and male sporophores (b).
8. A group of Moss plants with sporophytes.
9. A group of Moss plants with sporophytes at different stages.
10. One Moss plant with three sporophytes.
11. A Fern plant. The sporophyte only showing spore cases on the back of one frond.

All the drawings are two-thirds natural size.

flowerless plants, or 'Cryptogams' meaning 'hidden marriage' because they had no flowers and no visible means of sexual reproduction. The names have remained though nowadays with the higher powers of the microscope available, the methods of reproduction can be seen and studied in detail.

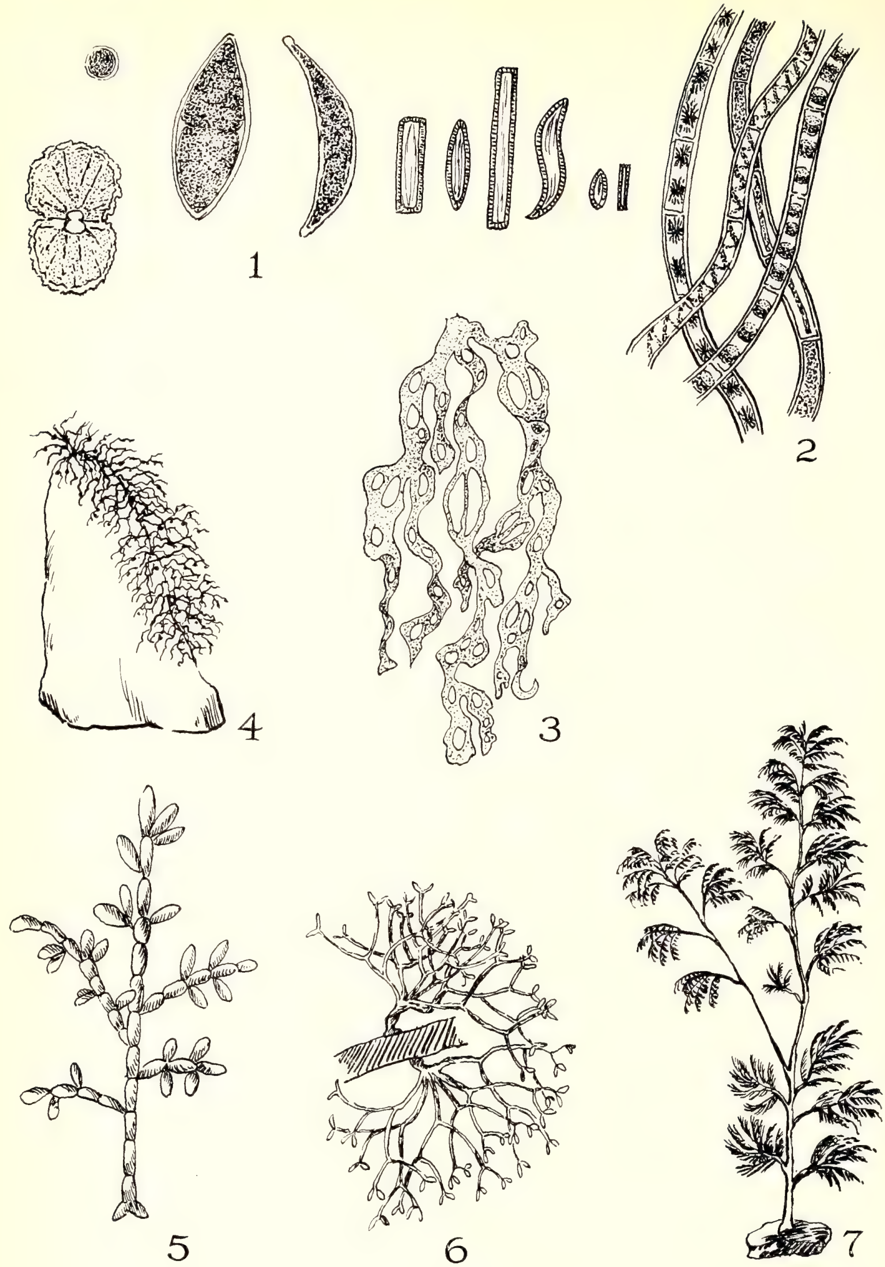
In their external morphology the Cryptogams show the very widest range of difference, and vary in size and complexity of structure, from the smallest of unicellular plants, visible only with the high powers of a microscope, to some of the largest members of the vegetable kingdom. The enormous tree ferns of a tropical forest, and the gigantic seaweeds of the Arctic Oceans, attain dimensions as great as or greater than many forest trees among the Phanerogams. In structure they show as great a variety, and the vegetative body of the plant, which is known in the lower Cryptogams as the *thallus*, may consist of only one cell, or a chain of simple cells, or a mass of threads woven together without any cellular structure, as in the fungi and lichens ; or it may consist of a flat, spreading, green plate-like cellular structure variously lobed or branched, but showing no differentiation into root, stem and leaves, as in some of the liverworts. In the higher Cryptogams however including other species of liverworts, the mosses, selaginellas and ferns there is a complete differentiation of the thallus into root, stem and leaf structures, and the internal cellular structure of the ferns resembles that of the flowering plants, having a well developed vascular system throughout. All the Cryptogams with the exception of the great group of the fungi, resemble the Phanerogams in containing the same green colouring matter, known as chlorophyll, which plays such an important part in the physiology of plant life. Under the influence of bright light, all plants containing chlorophyll can assimilate free carbon dioxide from the air, and from it manufacture various carbohydrates, principally starch, which are utilized in the growth of the plant. This process is known as *assimilation and photosynthesis*, and is of immense importance to the plant, which for healthy and vigorous growth must have plenty of chlorophyll and abundance of light and fresh air. The chlorophyll itself is not formed in plants from which light is excluded, such plants being of a pale yellow colour, and they rapidly die if continually kept in the dark, while if brought out into the light they soon become green. Chlorophyll is contained in special bodies, known as chloroplasts, occurring in the cells of the thallus, or of the stems and leaves of the higher plants and these chloroplasts can be well seen under the microscope as many little round green bodies, often nearly filling the cells, or as in the some of the green algæ assuming various shapes within the cell or cells composing the thallus.

In their methods of reproduction lie the essential differences between the two great divisions. All the Phanerogams produce a seed which is a multicellular body containing the germ or embryo of a new plant, while Cryptogams produce spores which are unicellular bodies containing no embryo.

A seed is formed by the union of a male cell from the pollen grain, with a female cell in the ovule of the flower. It contains, when ripe, besides the embryo which is already differentiated into root and shoot, a supply of nourishment stored in surrounding tissue for its use during germination, when it develops into a plant resembling its parent.

A spore is produced in two ways. It may be produced asexually, by simple cell division in the thallus, or in special structures borne on the thallus, or sexually by the fusion of two separate spores or cells. All Cryptogams produce asexual spores, and in some of them, the fungi and lichens for example, this is the only method of spore production, vast quantities of minute spores being formed in or on special fructifications called *sporophores* or *sporophytes*. But in other Cryptogams both methods are found, and the sexual process varies from a simple conjugation of two similar cells, as in some of the simpler algæ, to the formation of a spore by the union of two distinct male and female cells produced each in its own special organ. In the algæ the two methods may take place in the same plant, and seem to depend on the occurrence of favourable or unfavourable conditions, but in the higher Cryptogams, the two methods occur in regular alternation; that is to say, a sexually produced spore will develop into a plant or structure which produces only asexual spores, and these on germination give rise to a plant or structure which bears sexual organs from which the sexually produced spore is again formed. The life history of a moss or liverwort, selaginella or fern, thus includes two alternating generations, a sexual and an asexual—the small green moss plant produces male and female organs, and is therefore the sexual generation; in the female organ is produced a spore (by fusion of a female cell with a male cell from the male organ), from which develops the long stalked capsule found growing from the top of the moss plant. In the capsule are produced a number of spores by vegetative growth only, so that they are asexual spores, and the long stalked capsule is the asexual generation of the moss. The spores, when liberated from the capsule, develop into the little green moss plants, and the life cycle is complete. In the ferns, on the other hand, the leafy plant which is the more conspicuous generation is the asexual generation, the spores being produced vegetatively in special structures known as sporangia on the backs of the fronds. On germination these give rise to a very small moss-like structure known as the prothallus on which are borne the sexual organs and from which a sexually produced spore is formed. From this spore arises a new sporophyte generation on the prothallus which soon dies away, leaving the sporophyte to an independent existence.

With the exception of the lichens which can grow in the driest and most exposed situations, all the Cryptogams love plenty of moisture, and must be sought for in the wettest places. The algæ are almost entirely aquatic plants and are found both in fresh and salt water. The fungi, on the other hand, are rarely found in water, but only in very damp situations, and during or after the wet season. The majority are parasites or saprophytes, and old tree trunks, damp rotting leaves and decaying vegetation of all kinds, all offer suitable habitats for fungi, and a walk in the 'wet wild woods' after a period of continued rain, will reward the collector with a host of specimens of infinite variety of form and colour.



SOME OF THE GREEN AND RED ALGÆ.

1. Some types of unicellular Algæ, very highly magnified.
2. Threads of four different filamentous green Algæ, showing different shapes of chloroplasts in the cells, very highly magnified.
3. A marine green Alga, natural size. Flat ribbon-like thallus with large holes.
4. A freshwater red Alga growing on a stone. Two-thirds natural size.
5. 6. 7. Types of marine red Algæ. No. 5 slightly magnified. Coral-like appearance due to deposit of calcium carbonate in the cell walls.

Liverworts prefer the banks of streams or the rocks just above water level, and clothe large areas with a flat green covering, often mistaken for a moss. The true mosses and ferns also seek damp and shady situations and are found at their best in woods and near streams, a few of the mosses being aquatic, while some of the tiny filmy ferns that cling to the underside of boulders and rocks in the beds of streams can only live in a perpetually moist atmosphere.

With these few introductory remarks on the Cryptogams in general we will pass on to consider each of the groups a little more in detail and will begin with the algæ, dealing in later articles with each of the other groups in turn.

THE ALGÆ

The algæ form a very large group of plants, containing several well defined families or natural orders. They are all aquatic plants, being found both in fresh and salt water, the former inhabiting either the running water of streams and rivers, or the still waters of ponds and lakes, mountain pools or even merely the 'wetness' of damp rocks and tree trunks, during very rainy weather. The marine forms are found in every ocean or sea of the globe, spreading from the tropical seas of the Equator to the cold waters of the Arctic and Antarctic regions.

All the algæ contain chlorophyll, but some of them contain in addition another colouring matter, a blue-green, red or brown pigment, which masks the green of the chlorophyll and gives to the plant its own particular colour. These several colours appear in groups of plants which show similar characteristics so that the colouring is taken as the basis of a classification of the algæ and we get accordingly the blue green algæ or the Cyanophyceæ; the green algæ or Chlorophyceæ; the brown algæ or Phæophyceæ; and the red algæ or Rhodophyceæ.

The Cyanophyceæ are very simple plants, being unicellular, or grouped in colonies, or a chain of cells forming a fine thread or filament, too minute to be seen except with a very high power of the microscope. The threads are associated together into colonies and may be found as a bluish green felt-like or jelly-like substance on damp ground, or forming a thin layer at the bases of tree trunks in wet weather. Some species live in water and form a blue green scum floating on the surface of ponds and lakes or sticking to stones, sticks and other water plants, and some are found in sea water. Reproduction takes place by some of the cells breaking away and by simple division forming new colonies. No sexual reproduction has been observed.

The Chlorophyceæ are also very simple in structure, many of them consisting of only one cell (see Pl. II, fig. 1) or a colony of cells, or a chain of single cells forming a fine thread or filament (Pl. II, fig. 2).

The single-celled algæ may be found in water taken from almost any pond, pool or stream; and being relatively fairly large may be seen with a fairly low power of the microscope. They assume various shapes and most of them contain a large chloroplast almost filling the cell and making the entire contents look green. (Pl. II, fig. 1).

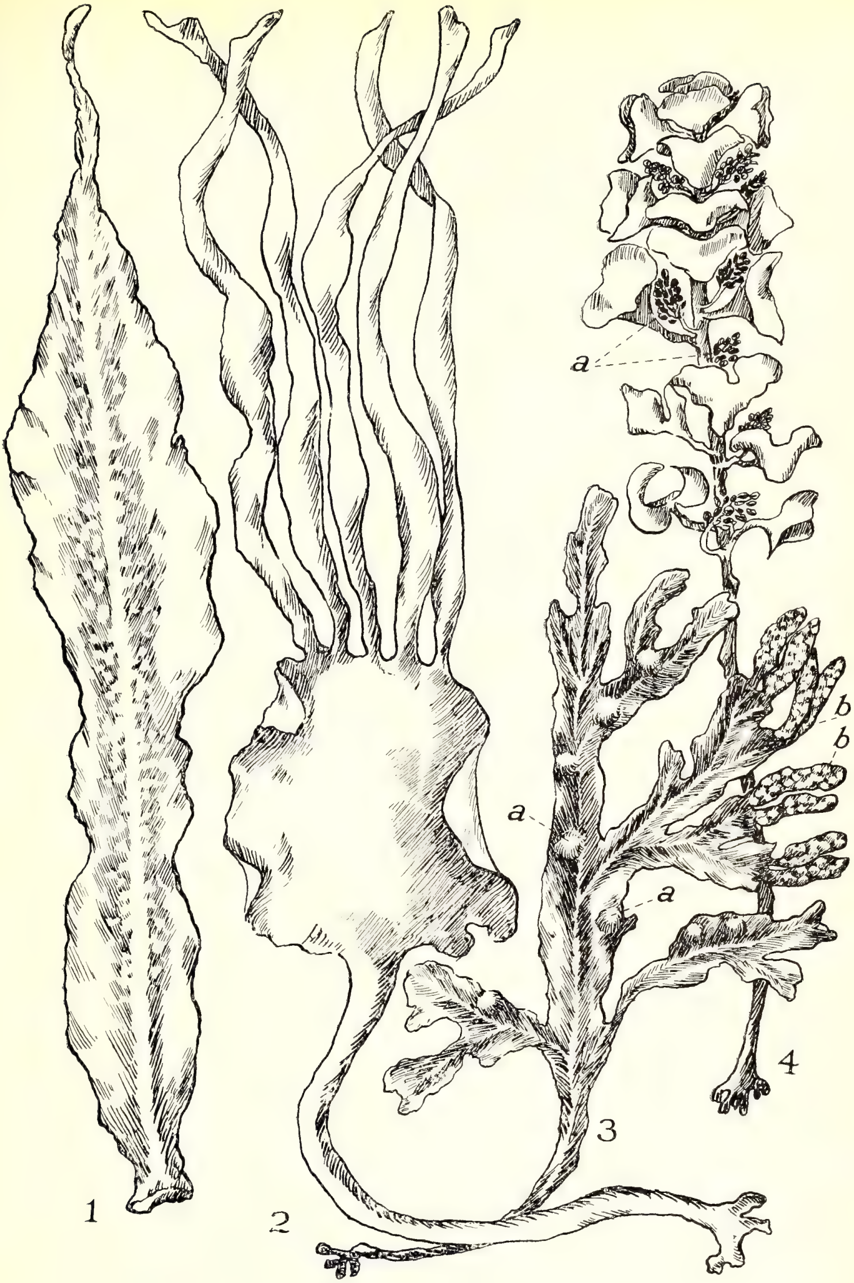
The filamentous green algæ can be seen with the naked eye, as masses of delicate green hair floating beneath the surface of the water—sometimes free—and sometimes attached at one end to stones or rocks in the bed of the pond or stream. Some species live in still water and some in running water—and though they all look very much alike to the naked eye, examination with the low power of a microscope reveals differences of structure, especially in the shape of the chloroplast, which sometimes appears as a flat plate almost filling the cell; sometimes winds about the cell in a spiral band, or assumes the form of a broad ring, or takes a star like shape. Species of Spirogyra are very common, and may be found in almost any stream and are easily recognized by the spiral chloroplast.

The Chlorophyceæ reproduce themselves by means of asexual spores produced by simple cell division ; but they also have a well marked method of sexual reproduction, in which the contents of two different cells fuse and form a resting spore from which a new plant develops.

The marine forms of the green algæ are often much larger and have a ribbon-like or plate-like thallus (Pl. II, fig. 2) more resembing some of the Brown Seaweeds, which with the exception of a few species are confined to sea water.

The Phæophyceæ or brown algæ contain a brown pigment, which gives to the whole plant a greenish or yellowish-brown colour ; it is soluble in fresh water and can be dissolved out, leaving the plant a greenish-yellow colour. Among the Phæophyceæ are found types ranging from the simple forms with a branching filamentous thallus, resembling the green algae, to the gigantic plants which inhabit the colder waters of the oceans, and have a complex thallus differentiated into root stem and leaf like structures (Pl. III, fig. 4). Air bladders developed in the thallus help to keep them afloat, and well developed reproductive structures which produce male and female spores are found sunk in the thallus as in Laminaria (Pl. III, fig. 1) where they are seen as little wart-like structures down the centre, or developed in the higher forms as distinctive structures (Pl. III, figs. 3 add 4). In the group represented by Laminaria (Pl. III, figs. 1 and 2) the long ribbon-like thallus often divides into several segments as in fig. 2. A second group—the Fucaceæ (fig. 3), has a thallus showing well marked dichotomous branching, and the rudimentary development of leaf-like structures, while reproductive organs are borne on the swollen tips of the branches. A third group which includes Sargassum (Pl. I, fig. 1) which grows in such quantities as to have given its name to a sea—and other species such as Pl. III, fig. 4, has a thallus almost as complex as a flowering plant, showing well developed root structures, stem, leaves and reproductive organs borne on special branches in the axils of the leaves.

The last group of the algæ, the Rhodophyceæ, or red seaweeds contain a bright red pigment, soluble in fresh water, which masks the chlorophyll and gives to the plants of this group their peculiar



SOME OF THE BROWN ALGÆ.

1. A species of LAMINARIA. Long ribbon-like thallus unbranched, reproductive bodies small nodules down the centre. Much reduced.
2. LAMINARIA DIGITATA. Thallus splits into several ribbon-like portions. Much reduced.
3. A species of FUCUS. Thallus branched dichotomously, bearing air bladders (a), and reproductive organs on separate branches (b). Two-thirds natural size.
4. A type showing differentiation into stem and leaf-like structures, and special reproductive branches (a). Two-thirds natural size.

beauty of colouring, which may range from a delicate rose to a deep purple. The red seaweeds (Pl. II, figs. 5, 6 and 7) are usually smaller and more delicate plants than the brown, and form little tufts growing on the rocks at the edges of deep pools on the shore, or just below low water mark. The thallus is usually filamentous or flattened and branches often dichotomously ; and in many species there is a deposit of calcium carbonate in the cells of the thallus, which gives the whole plant a thickened coral like appearance and has suggested the name Corallina for one of the genera (Pl. II, fig. 5). These species are usually found in the Tropics where the coast is exposed to a strong surf.

Both asexual and sexual spores are produced by the Rhodophyceæ. One or two genera of the Rhodophyceæ—such as Batracospermum (illustrated in Pl. II, fig. 4) are found in fresh water, and grow attached to stones or small rocks in the bed of streams.

A few of the seaweeds have a certain amount of economic importance. Some of the larger Phæophyceæ furnish a useful manure, while iodine is obtained from the ash, known as kelp, of certain of the Laminaria and Fucaceæ. Many of them, containing a kind of sugar, are used as articles of food by the Chinese and Japanese, and in Ceylon under the name of Agar-Agar in the preparation of a kind of jelly.

(*To be continued.*)

INDIAN DRAGONFLIES

BY

F. C. FRASER, LT.-COL., I.M.S., F.E.S.

Part XXXIII

(*With two plates and two text-figures*)

(*Continued from page* 301 *of this Volume*)

Subfamily AGRIONINAE Kirby.

Head transversely elongate; eyes globular, subpetiolate in some, and widely separated from one another; frons sloping, broader than long, or quadrate; occiput broad depressed; ante- and post-clypeus not elevated or projecting; antennae four-jointed, segment 1 rudimentary or hidden beneath the second which is the most robust and longest of all and usually applied flat to the head, third and fourth segments much more slender and usually shorter; labium deeply fissured for its distal third or half.

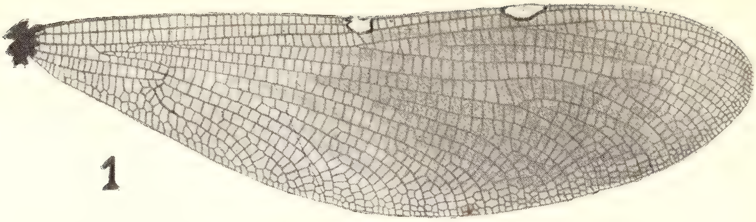
Prothorax robust, its posterior lobe large, tumid, triangular or crenate; middle lobe with a prominent boss on each side.

Thorax slender, flattened from side to side, elongate; mesothoracic triangle absent or very small. Legs long and slender, often very long, the hind pair extending to the middle of segment 3 or apical end of segment 4 in the male, or apical end of the 5th in the female; femora and tibiae with long fine closely-set, bristle-like hairs; claw-hooks short, situated near the end of claws.

Wings hyaline, opaque or partly so, coloured or uncoloured, often of a brilliant metallic colour or iridescent in the males, but very variable in both genera and species, usually hyaline and uncoloured in the female, the hind usually rather broader than the fore and considerably shorter than the abdomen in both sexes, base narrow but not petiolated; reticulation very close, cells mostly rectangular in shape; node situate about the middle of wing or nearer base than node; membrane of wing often markedly pleated; *Rii* contiguous or nearly so with the Radius near its origin; basal space reticulated, traversed or entire, equal to about half the length of cubital space; discoidal cell with the costal border slightly convex or straight, about equal in length to the basal space, very narrow, traversed by several nervures, its ends squared or a little oblique; arc straight or markedly angulate its sectors arising from a common point at its middle or below that level; *Cuii* markedly convex; *IA* markedly convex and often branching proximad; intercalated sectors between most sectors, including *Cuii* and *IA*; most sectors curving strongly towards the hinder margin of wing and, in some genera, pectinated near their distal ends; ante- and post-nodal nervures numerous, the primaries not usually distinct from the others and the costal and postcostal antenodals usually coinciding; pterostigma present or absent, often rudimentary in one or both sexes, very variable in shape and colour, sometimes false in character especially in the female.

Abdomen very long narrow and cylindrical, the end segments occasionally a little broadened and depressed; segment 10 rarely keeled and then only towards the apex.

Anal appendages all very similar in the genera, superiors rather longer than segment 10, subcylindrical, spined outwardly, curved forcipate like towards each other, the apices slightly flattened and often slightly broadened; inferiors about two-thirds the length of superiors, broad at base, tapering to a point,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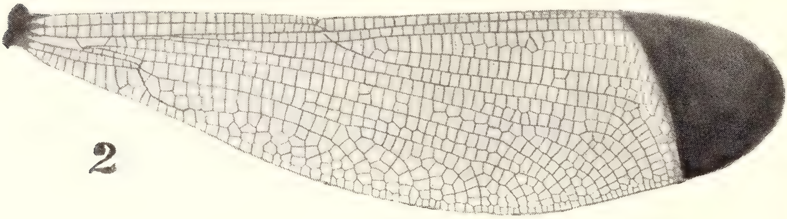
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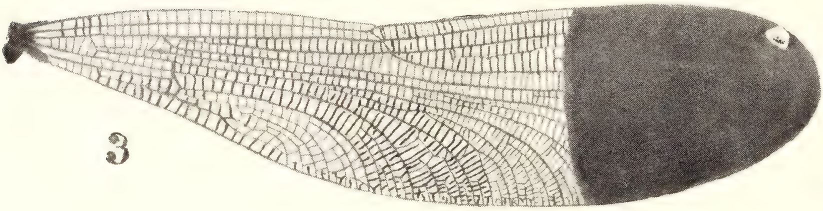
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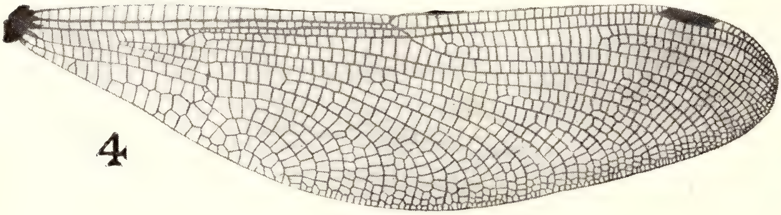
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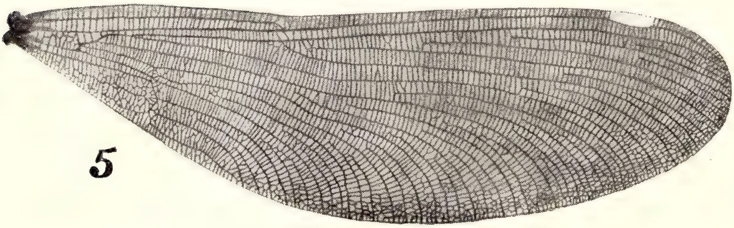
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Fig. 1. Hind wing of *Neurobasis chinensis chinensis* (Lin.) ♀
Fig. 2. Wing of *Vestalis apicalis apicalis* Selys, ♂
Fig. 3. Wing of *Echo margarita tripartita* Selys, ♀
Fig. 4. Wing of *Climacobasis modesta* Laid. ♂
Fig. 5. Wing of *Matrona basilaris nigripectus* Selys, ♀. (This wing has been shaded light in border to show the venation ; actually it is dark blackish-brown, the neuration invisible unless the wing be held up to the light.

straight conical. Genitalia very homogeneous; penile lobe flattened, elongate like the body of a tic; lamina deeply cleft; hamules consisting of a quadrate low-lying outer plate and an inner blunt spine.

Distribution. Throughout the world in temperate and tropical zones. Represented within Indian limits by six genera, viz.—*Neurobasis*, *Vestalis*, *Echo*, *Climacobasis*, *Matrona* and *Mnais*.

KEY TO GENERA

1.	Arc angulated; basal space traversed or entire; sectors of arc separated at origin; main sectors not forked; pterostigma absent or present ...	2
	Arc oblique, not angulated; basal space entire; sectors of arc arising from a single point; most main sectors forked; pterostigma absent.	*Vestalis*.
2.	Basal space traversed; pterostigma absent or present	3
	Basal space entire; pterostigma present ...	*Mnais*.
3.	Pterostigma present	4
	Pterostigma absent, or if present then abnormal and traversed by nervures	5
4.	Pterostigma differing in the two sexes, node situated nearer the pterostigma than base of wing	*Climacobasis*.
	Pterostigma similar in the two sexes, white or black in colour and broad and rather short; node situated nearer base of wing than pterostigma	*Echo*.
5.	All wings of both sexes opaque black; pterostigma white, traversed by nervures, absent in the male	*Matrona*.
	Forewings of both sexes hyaline, the hind opaque or hyaline; pterostigma absent in the male, false or absent in the female	*Neurobasis*.

Genus NEUROBASIS Selys (1853)

Neurobasis Selys, Syn. Cal. p. 17 (1853); Id. Mon. Cal. p. 72 (1854); Walk. List. Neur. Ins. B. M. iv, p. 602 (1853); Will. Proc. U. S. Nat. Mus. vol. xxxiii, p. 170 (1904); Munz, Mem. Ent. Soc. Amer. No. 3, p. 44 (1919).

Characters as for the subfamily; forewings of male hyaline, hindwings opaque and coloured partly with brilliant metallic green and blue; all wings of female hyaline but with an opaque whitish spot at the node; pterostigma absent in the male, false and whitish in the female; basal space traversed by several nervures; *Rii* near its origin almost confluent with the radius; *Riii* usually arising slightly proximad of the subnode; sectors of arc arising from near middle of arc which is distinctly angulated; anal area of wings reticulated but no distinct proximal branch running from *IA*.

Larvae very elongate and narrow, resembling a phasmid superficially; head rather small, eyes globular; antennae seven-jointed, the second joint very robust and longer than all the rest taken together; synthorax long and narrow, wing-cases leaflike, directed straight back and closely apposed to the body; abdomen cylindrical, long, narrow, tapering slightly towards the anal end; caudal gills three in number, triquetral in shape, the dorsal one shorter than the latero-ventral ones, which are very long and oar-like; legs long and spidery, slim; mask with middle lobe deeply cleft, setæ present on lateral lobes and branches of middle lobe, some robust spines on lateral lobes, one of which forms the movable hook; mask extending as far back as origin of hind legs. Genotype—*N. chinensis chinensis* (Linn).

Distribution. Southern Asia and South China, Philippines, Ceylon, Java, Borneo, New Guinea and Australasia. The genus contains two species, of which only one is found within Indian limits, viz., *chinensis*, of which several races or subspecies are known from the Philippines and the islands of south Asia. As regards the second species, *kaupi*, I regard it as belonging doubtfully to the genus.

Both sexes are found along the banks of streams and rarely if ever stray into the neighbouring jungles. Males are commonly seen flitting up and down stream, hugging the surface of the water so closely, that when passing over disturbed water, such as a rapid, they are seen to rise and fall, following the undulations and ripples of the water's surface. In this act, only the forewings of the insect are used to propel it, the hind being used as sustaining planes, outspread and motionless like the wings of an aeroplane, and flashing with a brilliant play of emerald green and peacock blue as the plane of the wings is altered to sustain the insect's balance. They rest on over-hanging ferns and herbage beside the parent stream or more commonly perch with closed wings on a rock in midstream. The female has somewhat similar habits but is not given to planing over water ; mating is rarely seen ; ovipositing takes place when the insects are *in cop* and this usually in a swift current, the insects clinging to some object such as the rootlets of a tree and descending far under water, where they are swept from side to side with every eddy of the current, the female meanwhile Sinserting her eggs in the substance of the root.

Neurobasis chenensis chinensis (Linn). (1758).

Libellula chinensis, Linn. Syst. Nat. i. p. 545, n. 15 (1758) ; Edwards, Nat. Hist. Birds, iii. t. 112 (1750) ; Donovan, Ins. China, t. 46, f. i, I (1798).

Agrion nobilitata, Fabr. Gen. Ins. p 248 (1776).

Agrion chinensis, Guérin. Icon. R. Anim., Ins. p, 382, t. 60, f. 4 (1829-44).

Calopteryx chinensis, Ramb. Ins Névrop. p. 226 (1842).

Calopteryx disparilis, Ramb. Ins. Névrop. p. 224 (1842).

Calopteryx sinensis, Walk. List. Neur. Ins. B. M. iv, p. 602 (1853).

Neurobasis chinensis, Selys, Syn. Cal. p. 18 (1853) ; Id. Mon. Cal. p. 72 (1854) ; Id. Bull. Acad. Belg. (2) xlvii, p. 359 (1879) ; Kirby, Cat. Odon. p. 102 (1890) ; Id. Journ. Linn. Soc. Zool. xxiv, pp. 545, 558 (1893) ; Selys, Odon. Jap. Ann. Soc. Ent. Belg. T. xxvii, p. 149 (1886) ; Först. Ann. Soc. Ent. Belg. xli, pp. 204–210 (1897) ; Kruger, Stett. Ent. Zeit, pp. 74, 75 (1898) ; Laid. Proc. Zool. Soc. Lond. pp. 86, 87 (1902) ; Will. Proc. U. S. Nat. Mus. vol. xxviii, p. 187, fig. 18 (1904) ; Laid. Fascic. Malay, *Odonata*, Part i, pp. 192–193 (1906) ; Ris, Ann. Soc. Ent. Belg. T. lv, p. 234 (1911) ; Id. Fauna Simalur. (*Odon*) p. 6 (1914); Laid Rec. Ind. Mus. vol. viii p. 340 (1914) ; Id. ibid. vol. xiii, p. 25 (1917) ; Tillyard, Biol. Drag. Pl. fig. 7 (1917) ; Munz, Mem. Amer. Ent. Soc. No. 3, Pl. iii, fig. 14 (1919) ; Fras. Journ. Siam. Soc. Nat. Hist. Suppl. vol. iii, No. 4, p. 459 (1919) ; Laid. Proc. Zool. Soc. Lond. p. 325 (1920) ; Fras. Journ. Siam. Soc. Nat. Hist. Suppl vol. iv, No. 3, p. 164 (1921) ; Id. Journ. Bomb. Nat. Hist. Soc. vol. xxix, p. 476 (1923) ; Id. Rec. Ind. Mus. vol. xxvi, pp. 428 and 479 (1924) ; Laid. Spolia Zeylanica, vol. xii, pts. 47–48, p. 355 (1924); Fras. Treubia, vol. viii, L. 3-4, p. 469 (1926) ; Fras. Journ. Siam Soc. Nat. Hist. vol. vii. No. 2, p. 88 (1927).

Male Abdomen 45–50 mm. Hindwing 32–38 mm.

Head : labium with middle lobe whitish, lateral lobes metallic green ; labrum turquoise blue with a large triangular medio-basal black spot with its apex directed towards the anterior border and sometimes meeting it ; cheeks and bases of mandibles palest blue ; anteclypeus with a small median yellow spot, the remainder and postclypeus glossy metallic green ; a large spot of yellow on each side of postclypeus ; rest of head metallic green with a coppery reflex on occiput and vertex ; antennae with the basal and second joints pale biue ; eyes blackish brown in the upper two-thirds, bluish green in the lower third, the two areas sharply defined.

Prothorax bronzed green with a coppery reflex ; posterior lobe truncate, its sides bluish white.

Thorax brilliant green metallic with the humeral and antero lateral blackish brown, the former diffusely so and clouded with bronzed brown anteriorly, the latter finely, the postero-lateral suture white, bordered with black, which is confluent in places, cutting up the white into spots ; beneath white barred with black ; tergum brown with metallic spots at bases of wings and two coral-white spots.

Legs very long and slim, the hind pair extending to apical border of segment 4 ; femora dark bronze, white on flexor surface changing to brown distad ; tibiae white, black on flexor surface ; tarsi black, Wings moderately rounded at apices, especially the hind ; forewings considerably longer than the hind, hyaline tinted with pale yellowish green especially along the costa and at apex, neuration brilliant emerald green especially the costa and main nervures, node thickened and narrowly clouded with brown ; hindwings opaque, the basal two-thirds brilliant metallic green or peacock blue according from which angle viewed, apical third blackish brown with violaceous reflex and green metallic nervures. The change from metallic green to black, near the apex, abrupt and nearly in a straight line from costa to hinder margin of wing, the basal space and some adjacent cells, and some of the basal cells of the costal space hyaline. Beneath wings, the fore similar to above, the hind of nearly uniform blackish brown with dull coppery or golden reflex, the neuration finely green metallic ; 6 to 9, usually 7, nervures in basal space ; discoidal cell traversed 7 to 13 times in forewings, 11 to 13 in the hind ; nodal index $\frac{65\text{–}44 \mid 41\text{–}63}{75\text{–}40 \mid 40\text{–}72}$; $\frac{59\text{–}35 \mid 42\text{–}60}{70\text{–}35 \mid 40\text{–}68}$; pterostigma absent in all wings.

Abdomen narrow and cylindrical, much longer than wings, green bronzed metallic above and at sides with the intersegmental joints brighter emerald green finely bordered with black ; beneath black, except segments 9 and 10 which are whitish.

Anal appendages black, the superiors with basal half dull metallic green, the inferiors white at base ; superiors slightly longer than segment 10, subcylindrical in the basal half, broadening and flattened in the apical and furnished along the outer border after the middle with 4 to 6 spines ; from above they are seen to curve gradually and evenly in, their apices almost meeting ; seen from the side, broad at base, tapering to a blunt apex. Inferiors one-fourth shorter than superiors, nearly straight, moderately separated, very broad at base then narrowing abruptly at junction of basal and middle thirds, ending in a blunt apex which is furnished with a small inwardly directed spine.

Female. Abdomen 44–50 mm. Hindwing 36–40 mm.

Differs in many respects from the male and therefore liable to be mistaken for a different species.

Head : labium pale yellow, white at base ; labrum, cheeks, bases of mandibles, the lower third of eyes and the two basal segments of antennae greenish yellow, the labrum with a small medio-basal tongue of black ; anteclypeus pale ; postclypeus metallic green with a small oval spot of pale yellow on each side ; upper two-thirds of eyes warm brownish black ; rest of head brilliant metallic green.

Prothorax and thorax as for male but the latter with humeral and lateral sutures finely white bordered with black, the latter confluent in parts so as to cut up the white into spots ; postero-lateral suture very broadly white, this colour completely framing the metepimeron enclosing an elongate triangle of metallic green which surmounts a large triangular patch of yellowish white below. Beneath thorax greyish white, unmarked with black.

Legs as for male but the pale parts creamy yellow.

Wings entirely hyaline tinted with yellow palely enfumed with brown, especially at apices and along costa from base to node in the forewings, and generally deeper in tint throughout the whole of hindwings, which have occasionally a diffuse denser patch nearly traversing the wings just proximad of pterostigma. All wings with an opaque creamy yellow patch at the node which usually covers one cell distad of node ; a creamy white pterostigma in the hindwings, variably present, reduced or entirely absent in the forewings, made up of 7 to 9 cells in the hindwing but sometimes with as many as 14, the nervures traversing it often incomplete and often missing in places ; made up of 1 to several cells in forewing when present. (In specimens from the Malabar Wynaad it is usually entirely absent in all wings, in Coorg forms it is very small and traversed by only 3–4 nervures and there is no widening of the gap between the costa and *Ri* as is usual in other species where the pterostigma is situated ; Nilgiri forms are variable, there being a vestigial pterostigma in one or other wing and none in the others ; in Siamese forms the pterostigma is better developed and there is a definite divergence of the costa from the radius, also in some specimens, the pterostigma is entire or at the most, a single traversing nervure at the two ends.) Other details of neuration similar to the male.

Abdomen dull bronzed metallic green with a golden reflex on dorsum, black beneath but thinly pruinosed. All segments with a lateral stripe on each side, rather obscure on segments 5 to 7, broad and conspicuous on 9 and 10, expanding at the apex of each segment as a large spot, which on segments 5 to 7, is usually the only vestige of the stripe present. The stripe bordered above and below with black. All segments with a transverse subapical black marking ; segments 8 to 10 with the dorsal carina yellow, this stripe broadening progressively as far as the apical end of segment 10 which ends in a distinct keel and a fine apical spine ; laterally segment 10 has a small tubercle on each side surmounted by some minute teeth.

Anal appendages stout, conical, pointed, rather shorter than segment 10, dark brown.

Vulvar scale greenish or olivaceous yellow, extending to apex of segment 10.

Distribution. Throughout India except in desert areas, up to about 7,500 ft. I have taken it at sea-level at Vizagapatam, in the Lova Gardens, and at Ootacamund on the kundah streams at 7,500 ft., but such situations are exceptional, 3,000 to 4,000 ft. being the altitude it usually favours. It breeds in montane and submontane streams, the larva clinging to roots and submerged water plants. I have examined specimens from Ceylon, South Kanara, Coorg, Malabar, Palni Hills, Deccan, Bengal, Assam, Burma, Siam and Annam and find remarkably little variation save in size ; females vary only as to the pterostigma, as already commented on above. Definite races are unknown within Indian limits. Specimens from Coorg and the Nilgiri Wynaad have the pterostigma in the forewings of females absent but well developed in the hind. Some of the Coorg females have the hindwings of a remarkably deep tint of burnt brown and the dark preapical fascia intensely developed. Females from the Palni Hills, 6,000 ft. have no pterostigma in forewings, but a single female from Ootacamund, 7,500 ft. has it well developed in all wings.

Although widely distributed, the species shows a predilection for certain streams, thus its local distribution takes the form of widely scattered colonies.

Genus VESTALIS Selys (1853).

Vestalis Selys, Syn. Cal. p. 24 (1853) ; Id. Mon. Cal. p. 79 (1854) ; Walk. List. Neur. Ins. B. M. iv, p. 610 (1853).

Characters as for the subfamily ; wings of both sexes rounded at apex, entirely hyaline or partly opaque or metallic ; pterostigma absent in both sexes ; basal space entire ; *Rii* confluent near its origin and for some distance with the radius ; *Riii* usually arising at or slightly proximad of the subnode ; sectors of arc arising from the lower part of arc ; discoidal cell equal in length to the basal space, traversed by several nervures ; arc not angulated ; anal area simple, *IA* not sending off any proximal branch ; *IA*, *Cuii*, *Riv* + *v* and *Riii* branched and pectinate at the distal ends, *MA* unbranched.

Legs long and spidery. Abdomen cylindrical slim and of great length. Ground colour of head, thorax, and abdomen metallic green or blue. Larvae very similar to that of *Neurobasis*. Genotype—*V. luctuosa* (Burm).

Distribution. Throughout the oriental region, Sondaic archipelago and Philippines. Five species taken within Indian and Ceylon limits.

Breeds in montane and submontane streams, gregarious in nature. Large colonies are found inhabiting the rides of open spaces in forests, and along some shaded pathways, almost every twig will be found to have its occupant. When aestivating or feeding up, it will spread far inland from its parent streams, thus I have found it on the top of wooded hills and it is not an uncommon insect on Malabar Hill, Bombay. It is as much a woodland insect as *Neurobasis* is a riverine one, but appears to resort to streams for mating, as courtship is never witnessed in the jungle. Unlike *Neurobasis*, the female oviposits in blades of grass or juicy stems overhanging a stream, often several feet above the water's surface, the newly hatched larvae dropping from thence into the water. (Similar habits have been noticed for *Lestes* and *Tetrathemis*.) By its habits and general facies, the genus is closely related to the African genus *Phaon* which has a similar scattered distribution throughout Africa and dominates the *Agrionidæ* there as does *Vestalis* throughout the oriental region.

KEY TO SPECIES OF GENUS *Vestalis*

1.	Apices of wings tipped with black	2
	Apices of wings hyaline	3
2.	Labrum entirely black ; Ceylon species ...	*V. nigrescens.*
	Labrum yellow marked with black ; Continental species	*V. apicalis.*
3.	Wings tinted uniformly with golden yellow ...	*V smaragdina.*
	Wings untinted or but partially so	4
4.	Two rows of cells between origins of *Cuii* and *IA*	*V. amœna.*
	Only a single row of cells between *Cuii* and *IA*...	*V. gracilis.*

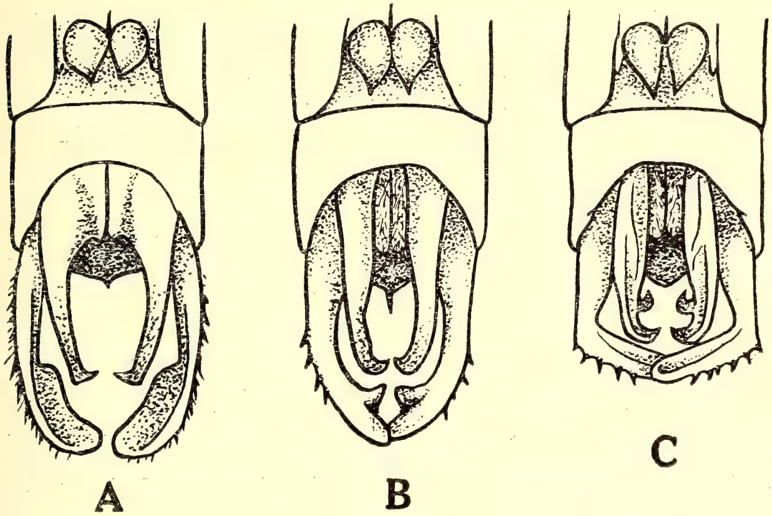


FIG. 1.

A. Anal appendage of *Neurobasis chinensis* Lin., seen form below.
B. The same of *Vestalis apicalis* Selys.
C. The same of *Caliphaea confusa* Selys.

Vestallis gracils gracilis (Ramb) (1842).

Vestalis gracilis, Selys, Syn. Cal. p. 26 (1853) ; Id. Mon. Cal. p. 84 (1854) ; Kirby, Cat. Odon. p. 102 (1890) ; Selys, Ann. Mus. Civ. Genov. (2), x (xxx), p. 55 (1891) ; Will. Proc. U. S. Nat. Mus. vol. xxviii, p. 183, fig. 15 (1904) ; Martin, Mission Pavie. Névrop. (sep.) p. 15 (1904) ; Munz, Mem. Amer. Ent. Soc. Pl. iv, fig. 18 (1914) ; Laid. Rec. Ind. Mus. vol. viii, p. 340, (1914) ; Id. Ibid. vol. xiii, p. 30 (1917) ; Fras. Journ. Bom. Nat. Hist. Soc. vol. xxix, p, 476, (1923) ; Id. Rec. Ind. Mus. vol. xxvi, p, 479 (1924)

Calopteryx gracilis, Ramb. Ins. Névrop. p. 224 (1842) ; Walk. List. Neur. Ins. B. M. iv, p. 611. (1853).

Male. Abdomen 45-56 mm. Hindwing 34-38 mm.

Head : labium yellow ; labrum, bases of mandibles, cheeks, anteclypeus, the two basal segments of antennae and an oblique oval spot on each side of frons converging on each other above, bright yellow, the labrum with a medio-basal triangle of black and occasionally an ill-defined bar of basal black ; the yellow spots on frons often obscure or even absent ; the basal joints of antennae occasionally dark brown ; rest of head brilliant metallic green with a golden reflex in some. Eyes dark brown in the upper two-thirds, greenish yellow in the lower and beneath.

Prothorax metallic emerald green on dorsum and sides, yellowish on the lower parts of sides and beneath. Posterior lobe truncate, bordered finely with yellow.

Thorax brilliant metallic emerald green, the middorsal carina finely black, the humeral and antero-lateral sutures finely yellow, the metepimeron yellow ochre except for a narrow elongate triangle of metallic green at its centre. Beneath and ventro-lateral borders yellow ochre, unmarked.

Legs pale to dark brown, the flexor surfaces of tibiae and extensor surfaces of femora paler or yellow. In some, the legs are dark reddish or blackish brown.

Wings hyaline, iridescent with colours of mother of pearl or blue in some lights, especially the central parts of forewings, tinted variably with greenish yellow as follows,—the whole of the hindwings uniformly, the base of forewings as far as out as the distal end of discoidal cell, the whole length of costa between the costa and nervure *Rii* and the extreme apex of wing. This tinting very variable and quite absent in teneral forms, always more intense in old adults and in forms from Assam, Burma and Siam, some of which, from the latter country, have the apices enfumed as well as tinted, although not to the same extent as in *apicalis*. Discoidal cell traversed 4–6 times in the forewing, 3-5 in the hind, the more eastern forms seeming to be the most closely reticulated; nodal indices of three random specimens,—$\frac{65–25}{53–24}\Big|\frac{26–65}{24–54}$; $\frac{66–28}{52–26}\Big|\frac{30–67}{24–57}$; $\frac{62–30}{50–24}\Big|\frac{26–54}{25–48}$.

Abdomen metallic green or blue, usually peacock-blue in tenerals, emerald-green in adults with a narrow interrupted basal yellow ring on segments 2 to 6, and the sides of segments 1, 2 and basal end of 3 yellowish. Beneath black. Segment 10 with a robust keel at its apical dorsal end which ends in an apical spine; a more or less robust spine on the apical border of same segment on each side.

Anal appendages black; superiors rather longer than segment 10, widely separated, broad at base then subcylindrical and finally flattened at apex where the end is bevelled and terminates in a sharp spine; a blunt dorsal conical spine at extreme base and some coarse spines along outer border, two or three of which are larger than the rest. Seen from above, these appendages are curved evenly inwards to almost meet at apex. Inferiors widely separated, about two-thirds the length of superiors, conical, tapering to an obtuse rounded apex.

Female. Abdomen 43–50 mm. Hindwing 36–39 mm.

Exactly similar to the male in colour and markings, but the abdomen usually more dully metallic and segments 8–10 yellow laterally.

Anal appendages and ovipositor dark brown, the former conical pointed, slightly shorter than segment 10 which latter is keeled and spined as in the male.

Distribution. That of the genus. After examining many scores of specimens from the Western and Eastern Ghats, Bengal, Assam, Upper and Lower Burma, Siam, Annam and Tonkin, I am unable to find differences of racial or even varietal value, unless it be that specimens from the latter three localities are of a deeper tint as to the wings. It is this tinting which serves to separate *gracilis* from *apicalis*, some specimens of the former occasionally having the apices of the wings enfumed and so liable to be confused with the latter. *Gracilis* and *apicalis* are frequently found in company, and taking pruinescence as a measure of full adulthood, we find specimens heavily pruinosed, in which there is either no sign of apical darkening of the wings or at the most, *a poorly defined shadow* of such. These specimens are the true *gracilis*; similarly pruinosed specimens of *apicalis* found in their company have the apices of wings deep blackish brown and *very sharply defined*. The great length of the abdomen of *gracilis* mentioned by Rambur, Selys and other authors, is not found to be constant when a large series of specimens is examined, the following ratios of wing length being found from different localities :—

	Abdomen	Hindwing
Nilgiris	46–53 mm.	35–38 mm.
Burma	45 mm.	36 mm.
Siam	45 mm.	35 mm.
Bengal	56 mm.	38 mm.
Eastern Ghats	50 mm.	34 mm.

Vestalis gracilis amæna subsp. nov.

Male and female. Measurements, colouring and markings exactly similar to *gracilis gracilis* but the venation corresponding to that of *amœna* in that there is only a single row of cells separating *IA* and *Cuii*. The venation is decidedly closer than in *amœna* and there are 3 to 4 rows of cells between *IA* and the hinder margin of wing as in true *gracilis*. On the whole this subspecies appears to be rather smaller than *gracilis gracilis* and may represent a bridge between two closely allied forms.

Distribution. Coorg and the Nilgiri Wynaad, all specimens taken at about 3,500 ft. altitude.

Vestalis apicalis apicalis Selys (1873).

Vestalis apicalis Selys, Bull. Acad. Belg. (2) xxxvi, p. 612 (1873) ; Id. ibid. (2) xlvii, p. 362 (1879) ; Kirby, Cat. Odon. p. 102 (1890) ; Id. Journ. Linn. Soc. (Zool.) xxiv, pp. 558–559 (1893) ; Laid. Rec. Ind. Mus. vol. xiii, p. 30 (1917) ; Fras. Journ. Siam. Soc. vol. iv, p. 164 (1921) ; Id. Rec. Ind. Mus. vol. xxvi, p. 479 (1924) ; Laid. *Spolia Zeylanica*, vol. xii, parts 47 and 48, pp. 355, 356 (1924).

Nurobasis apicalis Kirby, Proc. Zool. Soc. Lond. p. 204, pl. xx, fig. 2 (1891).

Male. Abdomen 49–55 mm. Hindwing 36–39 mm.

Head : labium, labrum, cheeks, bases of mandibles and basal joints of antennae coloured as in *gracilis gracilis*, rest of head metallic emerald green ; eyes brown in the upper two-thirds, olivaceous or yellow in the lower. Antennal basal joints often brownish black inwardly, and the labrum sometimes with a broad quadrate basal spot or broad blackish brown line.

Prothorax and thorax coloured similarly to *gracilis gracilis* but the posterior lobe of former more conspicuously bordered with yellow. Legs blackish brown, the flexor surfaces of femora, the extensor surfaces of tibiae and the coxae yellow.

Wings hyaline, adult forms sometimes tinted as in *gracilis* but not as deeply ; apices of all wings broadly tipped with blackish brown for about the distal 5 mm. ; venational details very similar to those of *gracilis* ; discoidal cell traversed 4 to 5 times in the forewing, 2 to 4 times in the hind ; 10 cubital nervures in the forewing, 8 to 9 in the hind ; nodal index—$\frac{66\text{–}30|30\text{–}65}{61\text{–}27|26\text{–}68}$;

$\frac{68\text{–}24|27\text{–}69}{54\text{–}24|24\text{–}55}$.

Abdomen metallic emerald green marked with yellow as in *gracilis* on segments 1 to 3 ; intersegmental nodes black ; obsolete subapical black transverse spots on segments 1 to 4, beneath black, often pruinosed more or less.

Anal appendages black ; superiors gradually curving inwards from base to apex, coarsely spined along the outer border, broad at base, subcylindrical thereafter but broadening at end and shallowly bifid at apex which is much broadened and bevelled inwardly, the inner end bearing a sharp spine, the outer truncate and blunt. Inferior appendages about two-thirds the length of superiors, cylindrical but broad at base, apices blunt.

Female. Abdomen 46–50 mm. Hindwing 38–40 mm.

Closely similar to the male ; the labrum usually with a basal line in continuation with the medio-basal black spot ; often an oblique paler area on each side of frons similar to that often seen in *gracilis*, and often a small pale area on the outer side of each lateral ocellus.

Thorax with humeral and lateral sutures yellow, the former and antero-lateral narrowly bordered with brown.

Wings similar to the male but the apical marking usually paler and less sharply defined.

Abdomen more coppery metallic and of a more dull metallic than in the male ; segments 2 to 5 with narrow basal interrupted yellow rings or paired subbasal spots ; the ventro-lateral borders of segments 1 to 4 or 5 yellow ; segment 10 with a well marked dorsal keel ending in a sharp spine, and with a smaller spine on each side. Ovipositor as in *gracilis*.

Distribution. Coincides closely with that of *gracilis*, but in Ceylon is replaced by a closely allied species. Nearly always found in company with *gracilis* and has exactly similar habits. Distinguished from other species by the black apices of wings.

Vestalis apicalis amæna subsp. nov.

Male and female closely similar to *apicalis apicalis* and bearing the same relation to it as does *gracilis amœna* to *gracilis gracilis*.

Differs from *apicalis* by the cheeks all glossy black and by the black apex of wings much restricted, occupying only about 2·5 mm. (in some specimens usually females, this marking is not sharply defined).

Venation resembling that of *amœna*, there being only a single row of cells between *Cuii* and *IA*; usually 3 to 4 rows of cells between *IA* and the wing border for a short distance. In some specimens the dorsal keel and spine are absent on segment 10, but the lateral spine is always present.

In a specimen from the Nilgiris, the labrum is bordered with black, the cheeks are entirely black; the thorax is a beautiful metallic emerald with black sutures, even the upper part of the postero-lateral suture being of this colour; the abdomen is very dull metallic, the end segments being matt black. In a specimen from Anantagiri, Eastern Ghats, the colouring is coppery or golden bronzed green, the head being coloured and marked as in the Nilgiri form; the thorax with the sutures black except the postero-lateral one; the abdomen is more brightly metallic; the size is much smaller (abdomen 47 mm. hindwing 34 mm.); the apices of all wings are deep black. These two forms may represent distinct races.

Distribution. Nilgiris and Eastern Ghats. Easily distinguished by the combination of apical black marking to all wings and a single row of cells between *Cuii* and *IA*, and the cheeks glossy black.

Vestalis nigrescens sp. nov.

Male. Abdomen 46–50 mm. Hindwing 35–37 mm.

Head: labium brownish yellow pruinosed white laterally and at base; labrum and epistome blackish brown; cheeks, bases of mandibles and basal segments of antennae black; rest of head dark metallic green with a blue reflex; eyes brownish black above, paler below.

Prothorax metallic green, borders of posterior lobe black.

Thorax dark metallic green, the dorsum with a peacock-blue reflex, middorsal carina finely black, humeral suture rather broadly outlined in black, antero-lateral suture finely black, postero-lateral suture cinereous bordered with black; beneath white with a posterior black spot which may be obscured by pruinescence. Legs entirely black.

Wings hyaline; apices of all, for nearly one-third of the distance from apex to node, deep black; nodal index similar to that of *apicalis*; 4 to 6 transverse nervures in the discoidal cell; 2 rows of cells between *Cuii* and *IA* at origins; *Riii* arising at, or slightly proximal or distal to the subnode.

Abdomen dark metallic green on segments 1 to 5, rest of segments matt black, intersegmental nodes blackish brown, base of segment 1 pruinosed white; segment 10 with a robust apical keel and spine on dorsum, and a lateral spine on each side.

Anal appendages black; superiors and inferiors showing no marked differences from those of *apicalis*, the lateral spines finer, the apex of superior appendages more truncate, the inferior appendages more sinuous and their apex with a fine point on the inner side.

Female. Abdomen 43 mm. Hindwing 38 mm.

Differs from the male by the labium whitish, labrum yellow with a mediobasal black triangular spot; cheeks, except against the eyes, bases of mandibles and basal segments of antennae yellow.

Thorax very similar to that of male but the antero-lateral suture with a trace of yellow, and the postero-lateral broadly so. Beneath yellow with a black triangular spot as in the male. Legs entirely black.

Wings hyaline, apices of all wings enfumed, this tinting vignetted off proximad. Details of venation similar to the male.

Abdomen with the metallic colouring confined to segments 1 and 2 and base of 3; segment 10 with a robust keel on dorsum, and lateral apical spines. Anal appendages short conical pointed black; ovipositor dark yellow.

Distribution. This beautiful species is confined to Ceylon and was discovered by Col. F. Wall, I.M.S., to whom I am indebted for specimens collected by him at Nalande, 11. ix. 24 and Kandy, 1. ix. 24, at 2,000 ft. The species is easily distinguished from others of the genus by its dark colouring which gives it a close superficial resemblance of *Echo margarita*, the dark metallic colouring being more similar to that species. The black labrum, antennae and legs and the non-metallic abdomen serve to distinguish it from *apicalis*. Laidlaw reports *apicalis* from Ceylon but has probably confused this species with it. He gives the following localities and dates for his *apicalis*,—' Kandy, July, November ; Ratnapura, October ; Haragama, July : Peradeniya December 29.'

Vestalis amæna amæna (Selys.) (1853).

Vestalis amœna Selys, Syn. Cal. p. 25 (1853) ; Id. Bull. Acad. Belg. (2), xxxv, p. 475 (1873) ; Id. Mon. Cal. p. 82 (1854) ; Kirby, Cat. Odon. p. 103 (1890) ; Krug. Stett. Ent. Zeit. p. 75 (1898) ; Laid. Proc. Zool. Soc. Lond. p. 87 (1902) ; Id. ibid. pp. 30–31 (1915) ; Karsch, Ent. Nachr. xvii, No. 16, p. 243 (1891) ; Will. Proc. U. S. Nat. Mus. vol. xxviii, p. 183 (1904) ; Laid. Proc. Zool. Soc. Lond. p. 326 (1920).

Calopteryx amœna Walk. List. Neur. Ins. B.M. iv. p. 611 (1853).

Male. Abdomen 38–52 mm. Hindwing 31–38 mm.

Head : labium yellow clouded with black in adults ; labrum black with a small yellow spot on each side at the base, or in subadults, yellow heavily bordered with black and with a medio-basal tongue of black ; the bases of mandibles and the base of the second joint of antennae yellow ; rest of head a beautiful dark metallic green ; eyes blackish brown above, paler below.

Prothorax metallic emerald green, the posterior border of posterior lobe finely yellow.

Thorax metallic emerald green with the humeral and first lateral sutures black ; hinder suture and posterior border of metepimeron yellow. Beneath pale yellow spotted with black. Legs dark brown to black, the hind femora paler or brown towards the proximal end.

Wings hyaline often with a pale yellowish green tinge and iridescent if viewed from an angle in a good light ; only a single row of cells between the proximal ends of *Cuii* and *IA* and only 2 rows of cells between the latter and hinder margin of wing ; the distal ends of main sectors curved down at a greater angle towards the hinder margin of wing ; discoidal cell traversed by 2 to 3 nervures in forewing, by 3 to 4 in the hind ; 9 to 10 cubital nervures in all wings ; nodal index, -- $\frac{55\text{–}25}{45\text{–}24}\Big|\frac{27\text{–}53}{25\text{–}42}$.

Abdomen metallic green passing to matt black after segment 4 or 5, segment 10 with a dorsal keel ending in a minute spine and with a small spine on each side of apical border as in *gracilis*.

Anal appendages black ; superiors rather longer than segment 10, curving gradually towards one another and almost meeting at apices, subcylindrical at base but compressed at apex and bifid so as to form two small branches, the upper or outer the longer, the other lower or inner short and blunt, spined coarsely on the outer side. Inferiors about two-thirds the length of superiors, widely separated at base, subcylindrical, nearly straight, apex blunt, base tumid.

Female. Abdomen 35–40 mm. Hindwing 34–39 mm.

Similar to male in markings and colouring and venational details ; nodal index, — $\frac{45\text{–}25}{35\text{–}18}\Big|\frac{24\text{–}47}{20\text{–}41}$; 8 to 10, cubital nervures ; discoidal cell traversed 2 to 3 times usually twice in all wings. Borders and apices of wings in old specimens enfumed with brown.

Distribution. The type comes from Java but the species appears to be wide spread, as I have seen specimens from Lower Burma, Sumatra, Borneo and Siam. The markings vary considerably according to the age of specimens, especially the labrum and antennae which may be quite black in old adults. The ground colour is peacock-blue in tenerals and changes gradually through brilliant emerald green to coppery or golden bronze. The colour of the labrum and venation will serve to identify it from other species.

Vestalis smaragdina (Selys) (1879).

Vestalis smaragdina Selys, Bull. Acad. Belg. (2), xlvii, p. 362 (1879) ; Kirby, Cat. Odon. p. 103 (1890) ; Selys, Ann. Mus. Civ. Genov. (2) x (xxx), p. 488 (1891) ; Will. Proc. U. S. Nat. Mus. vol. xxviii, p. 183 (1904) ; Ris. (subsp. *vellata*) Suppl. Ent. No. 1, p. 56, T. iv, fig. 2 (1912) ; Laid. Rec. Ind. Mus. vol. xiii, pp. 29 and 30 (1917).

Male. Abdomen 42–45 mm. Hindwing 32–35 mm.

Head : labium black ; whole of rest of head including the labrum, bases of mandibles, cheeks and basal segments of antennae brilliant metallic green or peacock-blue according from which angle viewed ; eyes brown above for the upper two-thirds, yellowish green below.

Prothorax metallic emerald green ; posterior lobe large, rounded.

Thorax brilliant metallic emerald green with a blue reflex on the dorsum ; lower half of sides including the whole of metepimeron, beneath thorax, and all the coxae bright yellow.

Legs very long and slim, brown in tenerals, black in adults.

Wings hyaline tinted with yellow throughout in subadults but only at the base in full adults, in which the wings have a pale greenish tinge ; only a single row of cells between *Cuii* and *IA* as in *amœna*, and not more than 3 rows between the latter nervure and hinder border of wing ; cubital space with the basal nervure (*ac*) usually isolated and with 2 or 3 nervures traversing it at its outer end ; discoidal cell traversed 2 or 3 times, usually only twice ; nodal index variable,— $\frac{54–20}{49–17}\Big|\frac{21–53}{17–48}$, $\frac{52–20}{45–18}\Big|\frac{21–53}{18–46}$, $\frac{40–24}{38–18}\Big|\frac{20–42}{17–37}$. (Discoidal cell traversed only once in all wings of one specimen.)

Abdomen metallic emerald green on dorsum and sides, black beneath ; segment 1 broadly citron yellow on the sides and base of dorsum, the end segments more dully metallic and often pruinosed white on dorsum. Segment 10 neither keeled nor spined.

Anal appendages black, rather longer than segment 10, curving in gradually to meet at apices but inclined to be angulated in at about the middle, outer border finely spined, base broad and with a very robust dorsal spine inclining outward, then subcylindrical and finally broadening out at apex which is deeply bifid, the outer branch much the longer, the inner about half its length and both rounded and blunt at apex. Inferior appendage about two-thirds the length of superiors, slim, cylindrical, ending in an acute inwardly directed spine.

Female. Abdomen 34–38 mm. Hindwing 30–34 mm.

Exactly similar to the male in colouring but the sides of segment 3 and lower parts of sides of segments 8 to 10 yellow. Segment 10 has a dorsal keel ending in an apical spine and a small spine on each side of the apical border as in *gracilis*. Vulvar scale robust, yellow.

Wings more highly coloured and evenly saffronated except in very old specimens, the nervures rich ochre ; venational details similar to the male.

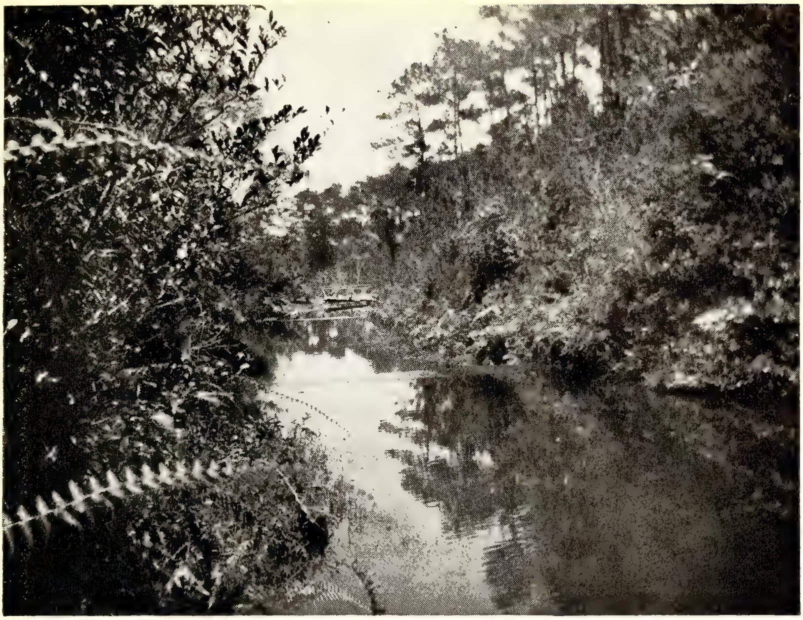
Anal appendages short conical pointed, brown or blackish brown.

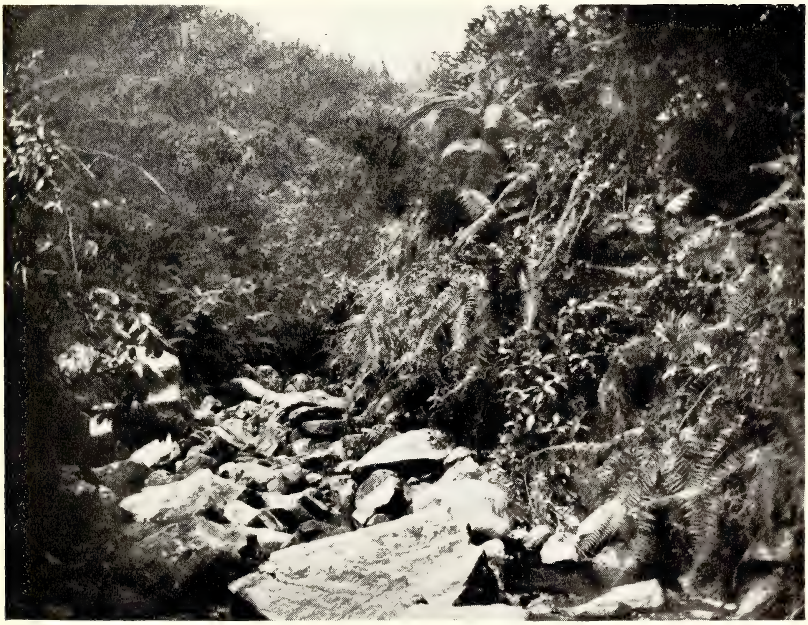
Distribution. Assam, Burma and Thibet. The type comes from the Khasia Hills, Assam, from where also the species has been taken by Mr. Bainbrigge Fletcher at Shillong, during the months of September to November, the earliest date being 18. ix., the latest 6. xi. Mr. Bainbrigge Fletcher sends me the following note about the species,—' One seen over small stream with muddy banks. Lower part of thorax sulphur yellow. Pruinosed marking on dorsal portions of posterior segments of abdomen very conspicuous when flying.'

Genus ECHO SELYS (1853).

Echo Selys, Syn. Cal. p. 19 (1853) ; Id. Mon. Cal. p. 67 (1854) ; Walk. List. Ins. Neur. B.M. iv. p. 604 (1853) ; Kirby, Cat. Odon. p. 101 (1890) ; Laid. Fascic. Malayenses (Zool.), part i, p. 192 (1903) ; Will. Proc. U. S. Nat. Hist. Mus. vol. xxviii, p. 170 (1904) ; Laid. Rec. Ind. Mus. vol. xiii, pp. 26–28 (1917).

Characters of the subfamily, ground colour dark metallic green and black ; thorax short robust ; legs long and slim ; abdomen slim cylindrical, considerably longer than the wings ; wings closely reticulated, hyaline or partly opaque





Photographs by *Mr. Bainbrigge Fletcher.*

Upper photograph shows a stream flowing from the lake at west end of fruit garden, Shillong, a favourite place for *Echo margarita tripartita* Selys. Lower photograph is that of a stream at east end of valley, Shillong, where are found *Matrona*, *Echo* and *Rhinocypha ignipennis* and *R. spuria*.

black in both sexes ; apices of all wings rounded ; pterostigma opaque white or black, short and broad, and of the same shape in both sexes, costal side shorter than the posterior which is markedly rounded, situated much nearer the apex of wings than is usual in the subfamily ; median (basal) space traversed by many nervures ; *Rii* near its origin, confluent with the radius ; *Riii* usually arising a little proximad of the subnode ; arc angulated, sectors of arc arising from it separately a little below its middle ; discoidal cell about equal to the length of median space, traversed by several nervures ; anal area moderately simple ; *1A* strongly forked a little after its origin ; none of the sectors pectinate or branched but numerous intercalated sectors between all main nervures ; node situated nearer base of wing than to pterostigma.

Larva somewhat similar to that of *Neurobasis*. Genotype—*Echo margarita margarita* Selys.

Distribution. Assam and Upper Burma. Selys given ' China ?' as the locality of the genotype but this is probably an error. Dr. Laidlaw (Rec. Ind. *Mus.* vol. xiii, pp. 26 and 28.) cousiders that his genus *Climacobasis* is synonymous with *Echo* but this is due to an error in his interpretation of the Selysian description of *E. margarita* and secondly to a wrong impression gained of the shape of the pterostigma in a male in the Indian Museum collection. He states that,—' When Selys described the male of *E. margarita*, he did not call attention to the difference in the shape of the pterostigma in the two sexes ' but as the shape is identical in the two sexes, there was no call for Selys to make any comment on this point. As regards the specimen in the indian Museum, I have made a re-examination of it and find that its pterostigma does not differ from that of the female. For reasons mentioned under genus *Climicobasis*, I consider it a good genus. Dr. Laidlaw also suggests that Kirby's *Archineura* and Martin's *Echo maxima* also belong to genus *Echo*. As regards the former, the basal neuration is so different that one cannot reconcile it with *Echo*, and in regard to the latter, I have since made an examination of the type and find important differences in the venation, thus *Rii* is not confluent with the radius at its origin, being similar to the condition found in genus *Matrona* ; the pterostigma is elongate in both sexes and situated in the usual place, viz. moderately far back from the apex, the wings are longer, the apices less rounded ; the anal area of wings more complicated and the node situated neare the pterostigma than base of wing as in *Clmacobasis*. Thus the genus contains but two species and one subspecies or race,—*E. margarita margarita* Selys, *E. margarita tripartita* Selys, and *E. uniformis* Krug., of which only the two former have been reported from within Indian limits.

These insects breed in montane streams, the adults being found along the banks settled on ferns or overhanging vegetation and with a slow flitting flight similar to *Vestalis*.

Echo margarita margarita Selys. (1853).

Echo margarita Selys, Syn. Cal. p. 19 (1853) ; Id. Mon. Cal. p. 67 (1954); Id. Bull. Acad. Belg. (2) xlvii, p. 356 (1879) ; Kirby, Cat. Odon. p. 101 (1890) ; Laid. Rec. Ind. Mus. vol. xiii. pp. 26-28 (1917).

Male : Abdomen 44-46 mm. Hindwing 36-37 mm.

Head. labium black ; labrum glossy black ; cheeks, bases of mandibles anteclypeus and antennae matt black ; postclypeus glossy metallic dark bronzed green ; eyes black above, pale brown to dove grey below. Rest of head dull metallic dark bronzed green.

Prothorax shiny metallic dark green, pruinosed beneath.

Thorax on dorsum and whole of sides dark metallic green with a coppery reflex, beneath black and thinly pruinosed. Legs black ; femora pruinosed thinly on flexor surface.

Wings hyaline except the apices which are dark blackish brown for about one-fifth the length of wing or about one-third or less of the distance between peterostigma and node ; a slight clouding of brown at the node in all wings ; the inner border of the dark area running almost straight back from costa to hinder margin of wing ; hyaline area with a beautiful bluish purple iridescence; pterostigma milky white in all wings, about twice as long as broad, distal end rounded, proximal end pointed, posterior border markedly rounded, the space distal to the pterostigma reticulated with a double row of cells ; discoidal cell traversed 7 to 9 times ; basal space traversed 6 to 9 times ; 16 to 18 cubital nervures ; nodal index ,— $\frac{69-38}{65-28}\Big|\frac{38-73}{29-64}$, $\frac{56-30}{56-30}\Big|\frac{37-58}{30-58}$.

Abdomen uniformly dark blackish brown, non-metallic, thinly pruinosed beneath. Anal appendages black ; superiors tumid at base, then subcylindrical, finally compressed at apex and curving gradually in towards one another ; outer border coarsely spined ; apices blunt. Inferior appendages very broad at base, very narrow and slightly sinuous thereafter, apices slightly clubbed and with a minute inwardly directed spine.

Female. Abdomen 37–41 mm. Hindwing 35–37 mm.

Closely similar to the male both as regards colouring of body and wings. Old specimens have the hyaline area of the wings variably enfumed, often of a warm brown and then lose their bluish iridescence. The pterostigma is usually slightly shorter and broader than in the male so that it is subrotundate or pyriform in some specimens. Venational details are similar to the male.

Vulvar scale very robust, extending to end of abdomen, black ; anal appendages short conical acutely pointed, black.

Distribution. Cheerapunji, Assam. I have seen but one specimen of this beautiful insect, a very dilapidated male in the Indian Museum collection from Cheerapunji, taken by Dr. Kemp in October . The type is a female in the Selysian collection labelled ' China ? ', and there is also a male in the same collection from the same locality as that of the Indian Museum specimen.

Echo margarita tripartita, Selys (1879).

Echo margarita race *tripartita* Selys, Bull. Acad. Belg. (2) xlvii, p. 356 (1879) ; Kirby, Cat. Odon. p. 101 (1890) ; Laid. Rec. Ind. Mus. vol. xiii, pp. 26–28 (1917).

Differs only from *E. margarita margarita* by the greater extent of black on the wing apices which covers roughly the outer third of all wings but is subject to slight variations. In some specimens it extends more than halfway from pterostigma to node, in others, slightly less than this distance.

Distribution. The type is from the Khasia Hills and is a male in the Selysian collection ; it is probably from Shilling, where Mr. Bainbrigge Fletcher has found the species moderately common from June to October. I am indebted to him for a nice series of this beatutiful insect. A distance of some 30 miles separates the localities of the two forms and it is possible that the future may reveal specimens from intervening localities connecting up the two, but until this has become an accomplished fact, it is preferable to regard them as two distinct subspecies or races. It is to be noted that the climatic conditions of the two localities differ widely, that of Shillong being comparatively dry, whilst Cheerapunji is credited with being the wettest spot on earth. Mr. Bainbrigge Fletcher sends me the following notes from Shillong,—' *E. margarita* ***tripartita*** common beginning of August 1919, beside footbridge over stream at West entrance of Fruit Garden. Few or none seen after middle of August. Beginning of September a few in other localities, 5. ix. 19, 3 along Cave Stream, mostly females. Weak flight, sits on bushes overhanging banks and on rocks in midstream. Also along pebbly bottomed swift streams. Never over muddy water. Never seen pairing or ovipositing. Occurs from June to August and struggles into September, last specimen seen 12. ix. 19.

Genus CLIMACOBASIS Laidlaw (1902)

Climacobasis, Laid. Proc. Zool. Soc. Lond. (1) p. 85 (1902) ; Will. Proc. U. S. Nat. Mus. vol. xxviii, p. 170 (1904) ; Laid ; Rec. Ind. Mus. vol. xiii, p. 26 (1917).

Characters of the subfamily and largely those of genus *Echo*, from which it differs by the following characters,—Wings entirely hyaline, apices less rounded, pterostigma in the male elongate and of normal shape, situated more proximal of the apex of wing, much reduced and more or less vestigial in the female ; node situated much nearer pterostigma than to the base of wing ; *Rii* fused with radius in forewing but not in the hind ; sectors of arc arising from a common point and occasionally fused at origin ; abdomen much more slender and comparatively longer.

Genotype—*Climacobasis modesta* Laid.

Distribution. Borneo, Siam, Assam and probably widely but sparsely distributed over the intervening region and throughout S.E. Asia.

As mentioned under genus *Echo*, Dr. Laidlaw came to the conclusion that his genus was synonymous with *Echo*, but the position of the node, the similarity of the pterostigma in the sexes of *Echo*, the separated sectors of the arc and the shorter, more robust abdomen of the latter genus, seem to definitely rule out *Climacobasis*, so that the genus still stands.

Climacobasis modesta Laid. (1902).

Climacobasis modesta Laid. Proc. Zool. Soc. Lond. (1) p. 84 ; Pl. vi, fig. 6 (1902) ; Will. Proc. U.S. Nat. Mus. vol. xxviii, p. 186, fig. 17 (1904).

Climacobasis lugens, Laid. Proc. Zool. Soc. Lond. (1), p. 85, Pl. vi, fig. 5 (1902).

Echo (*Climacobasis*) *modesta* Laid. *Fascic. Malayenses* (Zool) Pt. i, p. 191 (1903).

Echo modesta Laid. Proc. Zool. Soc. Lond. (1), p. 84, Pl. vi, fig. 6 (1902) ; Id. Rec. Ind. Mus. vol. xiii, p. 28 (1917).

Male : Abdomen 52–54 mm. Hindwing 37–39 mm.

Head : labium black ; cheeks and bases of mandibles glossy black ; anteclypeus dark brown ; postclypeus and rest of head dark metallic green, but in adults, the frons and ocellar space pruinosed snowy white ; eyes dark brown above, paler beneath.

Prothorax and thorax dark metallic green with a coppery bronzed or golden reflex, beneath black (but usually white with pruinescence in adults). Legs long slim black.

Wings entirely hyaline iridescent with purplish blue ; apices in adults enfumed, especially that of forewing, and sometimes a cloudy fascia extending over the distal two-thirds of the space between the node and base of wing, especially in the forewing ; pterostigma black, elongate, narrow, oblique at both ends but more pointed proximad ; basal (median) space traversed by 8–9 nervures in all wings ; discoidal cell traversed by 7 to 10 nervures, usually by 7 ; 16–18 cubital nervures ; nodal index, $\frac{42\text{–}39 | 40\text{–}43}{33\text{–}31 | 34\text{-}40}$, $\frac{39\text{–}36 | 35\text{–}40}{33\text{–}31 | 33\text{–}32}$.

Abdomen dark metallic green on segments 1, 2, and base of 3, black for the remaining segments. Anal appendages black ; superiors slightly longer than segment 10, broad at base, curving gradually in to almost meet at apices, subcylindrical after the base and slightly compressed at apex which is truncate and obtuse ; outer border coarsely spined ; inferior appendages almost two-thirds the length of superiors, broad at base, then cylindrical, narrow, apex blunt but furnished with a minute inner spine.

Female. Abdomen 46 mm. Hindwing 41 mm.

Closely similar to the male but differing in regard to the wings, in which the pterostigma is much reduced, being about one-third the length of the male, its hinder border nearly twice the length of the costal and somewhat rounded ; two rows of cells in the space between the costa and radius distad the pterostigma ; about 50 postnodal nervures, the increase in number over that found in the male being due to the shorter pterostigma.

Vulvar scale robust, extending to end of abdomen. Anal appendages about as long as segment 10, black, pointed.

Distribution. That of the genus. I have seen a specimen from the Pusa collection which was collected either in Assam by Mr. Bainbrigge Fletcher, or at King Island, Mergui, Burma, by Mr. Elton Bott. At the moment I have mislaid the note and cannot say which is the correct locality, but the latter is probably the more likely. Nothing is known of the habits of this insect but it probably closely parallels *Vestalis* in its breeding places.

Genus MNAIS Selys (1853).

Mnais Selys, Syn. Cal. p. 20 (1853) ; Id. Mon. Cal. p. 63 (1854) ; Walk. List. Neur. Ins. B. M. iv. p. 605 (1853) ; Kirby, Cat. Odon. p. 101 (1890) ; Will. Proc. U. S. Nat. Mus. vol. xxviii, p. 184 (1904) ; Ris, Supplm. Ent. No. v, pp. 8 and 9 (1916) ; Laid. Rec. Ind. Mus. vol. xiii, p. 29 (1917) ; Munz, Mem. Amer. Ent. Soc. No. 3, p. 44 (1919).

Characters of the subfamily ; ground colour dark metallic green or black, often pruinosed in parts such as the head, dorsum of thorax and terminal segments of abdomen. Thorax short robust; legs long and slim; abdomen moderately robust, or long and slim, cylindrical, longer than the wings; wings very closely reticulated, hyaline or partly opaque black, or tinted with greenish yellow or bright golden yellow; apices rounded; pterostigma very variable in the species, usually red in the male, white or cinerous in the female, often vestigial, especially in the female in which it may be entirely absent; arc angulated; sectors of arc arising from a common point a little below the middle of arc; median (basal) space entire; *Rii*, near its origin, confluent with the radius; *Riii* arising at or a little distad of the subnode; discoidal cell convex towards the costa, traversed by many nervures; anal area simple; *IA* forked a little after its origin, the hinder branch of fork weakly or not branched; main nervures rarely forked; many intercalated sectors; node situated nearer the base of wing than to pterostigma.

Larva unknown. Genotype *Mnais pruinosa* Selys.

Distribution. Northern India, Burma, Siam, Tonkin, Annam, South China and Japan. Some obscurity still exists as to the number of species or races belonging to this genus, Selys being of opinion that there were but two species with a number of races or possibly merely age phases of the same insect. It seems fairly clear however that such is not the case and that there are two well defined groups separated by the neuration black and the membrane of wing uncoloured in the one, and the neuration reddish and the wing membrane bright golden yellow in the other. To the former group we may add *Mnais maclachlani* Fras. in which the wing is partly opaque black with an outer bordering to the dark area milky opalescent white. Williamson splits up the species into two groups,—Palaearctic and Oriental, but the characters he gives are not always constant, even in the same species. The species so far described are,—*M. pruinosa* Selys, *M. costalis* Selys, *M. strigata*, Selys, *M. andersoni* MacLachlan, *M. earnshawi* Will. *M. mneme* Ris and *M. maclachlani* Fras., but an eighth and new species is described below. Only three species are known from within Indian limits. Nothing has been noted about their habits.

KEY TO SPECIES OF GENUS *Mnais*

1.	Venation reddish; wings tinted with golden yellow	2
	Venation black; wings untinted or at the most with a faint greenish tint	*M. andersoni.*
2.	Pterostigma quadrate or only as long as broad ...	*M. earnshawi.*
	Pterostigma elongate, more than twice as long as broad	*M. icteroptera.*

Mnais andersoni MacLachlan (1873).

Mnais andersoni, MacLach. Bull. Acad. Belg. (2) xxxv, p. 472 (1873); Kirby, Cat. Odon. p. 101 (1890); Selys, Ann. Mus. Civ. Genov. (2) x (xxx), p. 485 (1891); Id. Ann. Soc. Ent. Belg. T. xxvii, p. 52 (1883); Will. Proc. U. S. Nat. Mus. vol. xxviii, p. 184 (1904); Ris, Suppl. Ent. No. v. pp. 8, 9 and 11 (1916); Laid. Rec. Ind. Mus. vol. xiii, p. 29 (1917).

Male. Abdomen 35-42 mm. Hindwing 26-33 mm.

Head: labium black; labrum and clypeus metallic emerald green; bases of mandibles, adjacent parts of cheeks and the base of second segment of antennae bright yellow; rest of head metallic green with a coppery or golden reflex; eyes brown above, paler below.

Prothorax and thorax brilliant metallic emerald green, the latter with a coppery or golden reflex on dorsum; antero-lateral suture finely black, postero-lateral narrowly yellow, as also the hinder half of metepimeron. Beneath yellow with a large spot of black, pruinosed in adults. Legs black, coxae and trochanters pruinosed white.

Wings hyaline tinted with pale greenish yellow or quite colourless; reticulation black; pterostigma small, about as long as broad, outer border straight, inner border slightly oblique, posterior border slightly rounded, variably black or dark brownish; only a single row of cells between costa and radius after the pterostigma ; 11–13 cubital nervures ; discoidal cell traversed 4–7 times ; nodal index, $-\frac{30-23}{31-20}\Big|\frac{22-34}{25-30}$; *IA* forked shortly after its origin, its branches streaming distad ; anal area simple ; *Riii* arising variably at, or well distad of the subnode.

Abdomen black, segments 1 to 3 or 4 bronzed metallic green or blue in sub-adults remainder black, but segments 8 to 10 in adults pruinosed chalky white on dorsum ; beneath black.

Anal appendages black ; superiors tumid at base, subcylindrical at middle and compressed and slightly expanded at apex, which is obtuse, coarsely spined along outer border ; inferior appendages about two-thirds the length of superiors (which are slightly longer than segment 10), thick at base, then cylindrical and tapering to apex which is curved slightly in and ends in a minute point.

Female. Abdomen 32–37 mm. Hindwing 30–34 mm.

Closely similar to the male ; wings limpid ; pterostigma smaller, red, brown or cinereous, varying in shape and size, even in the wings of a single specimen (In a specimen before me, one wing has the pterostigma blackish and as well formed as in the male ; in another wing it is minutely triangular, the bordering nervures meeting at the radius, brown in colour ; in a third wing it is normal in size but is only faintly and partly coloured at the inner costal angle, whilst in the fourth wing it is almost square, the outer border slightly oblique, the colour cinereous). The second segment of antennae wholely bright yellow ; abdomen entirely metallic green from base to apex, black beneath.

Anal appendages black, conical, pointed at apex, about as long as segment 10. Vulvar scale robust, extending to end of abdomen.

Distribution. Burma, South China, Formosa, Siam and Tonkin. Probably widely distributed over southern Asia. Nothing is known of its habits but it is certainly a riverine breeder and probably submontane in habitat. I have a female taken at an altitude of 5,500 ft. in April. Localities given by Selys are,—Leito, Burma in April and May, Cobapo in September, October and November, Meteleo and Puepoli in the same months, and from Iado at the beginning of April. Williamson gives Toungoo, Burma as a locality for his material. Much more material of these interesting insects is needed before we can definitely settle their relationships.

Mnais earnshawi Will. (1904).

Mnais earnshawi Will. Proc. U. S. Nat. Mus. vol. xxviii, pp. 185, 186 (1904) ; Ris. Suppl. Ent. No. v, pp. 8 and 10 (1916) ; Laid. Rec. Ind. Mus. vol. xiii, p. 29 (1917) ; Fras. Journ. Siam. Soc. Nat. Hist. vol. iii, No. 4, pp. 460, 461 (1919).

Male. Abdomen 40–44 mm. Hindwing 33–37 mm.

Head : labium black ; labrum and clypeus glossy metallic emerald green ; bases of mandibles and the adjacent portion of cheeks bright yellow, rest of cheeks glossy black ; antennae black but the second segment variably bright yellow from base to its middle or nearly to apex ; rest of head dull dark green metallic ; eyes dark brown above, paler below.

Prothorax and thorax dark metallic green, the dorsum of latter between the humeral sutures and including the antealar sinus, chalky white with pruinescence ; laterally the postero-lateral suture, and rather more than one-third the hinder surface of metepimeron bright yellow. Beneath thorax black, pruinosed white. Legs black, ciliae numerous and very fine.

Wings hyaline tinted from base to apex with bright golden or amber yellow ; reticulation reddish, the costal half of wings more deeply tinted, the costa somewhat darker from node to base ; pterostigma very small, rather less than 1 mm. in length, variable in size and shape, usually with the costal border about two-thirds the length of posterior, the outer border straight, the proximal very oblique, the posterior rounded, deep blood red in colour, this colour sometimes spreading beyond the bordering nervures of the pterostigma distad and proximad ; discoidal cell rather convex costalwards, traversed 8–9 times in the forewing, 6 in the hind ; 12–15 cubital nervures ; usually only a single row of cells in the space after the pterostigma but occasionally two ; *Riii* arising widely distad of the subnode in forewing, a shorter distance in the hind ; *IA* forked shortly after its origin but its branches running distad ; anal area simple ; some of the main nervures occasionally branched.

Abdomen with segments 1 and 2 dark glossy metallic green, remaining segments black bronzed metallic especially 9 and 10; segments 8 to 10 pruinosed in adults. Anal appendages black; superiors curving gradually inwards to meet at apices, thick at base, then subcylindrical and finally compressed and slightly broadened at apices which are obtuse, outer border coarsely spined. Inferior appendages slightly shorter than superiors, broad at base, then cylindrical and with a minute spine at inner side of apex.

Female: Abdomen 34–41 mm. Hindwing 30–36 mm.

Very similar to the male but the wings differing in some important respects, —the tinting a much paler yellow, or entirely colourless; the reticulation reddish brown, the pterostigma white or cinereous or occasionally quite uncoloured or entirely absent, usually much smaller than in the male and abnormal in shape, sometimes triangular framed by two nervures which meet either at the costa or at the radius, sometimes represented by a mere bordering of opaque white on one or both sides of a postnodal nervure. Thorax and abdomen without pruinosed areas.

Anal appendages small, pointed, conical, black. Vulvar scale robust, extending to end of abdomen, blackish brown in colour.

Distribution. Burma, Siam, Tonkin, Annam, Formosa and South China. I have not seen specimens from Burma and, unfortunately, the author's description of the type is confined entirely to the wings. Thus the above description, which is the first full one to be made, is made from specimens from Siam and Annam. So for as size and the wings are concerned, they agree entirely with that of Williamson's description of Burmese specimens. The specimens from South China and Formosa described by Dr. Ris. loc. cit. are decidedly larger, as is also the pterostigma, they have also a much greater extent of yellow on the sides of thorax, so that I consider these a distinct race.

Mnais icteroptera, sp. nov.

Male: Abdomen 47 mm. Hindwing 36 mm.

Head: labium black; labrum, clypeus and occiput brilliant metallic green, the labrum with a bronzed or golden reflex. the upper part of head emerald but the whole space confined between the antennae on either side, the clypeus, and middle ocellus, pruinosed chalky white; antennae black, the second segment and base of third bright yellow; bases of mandibles and cheeks adjoining the mandibles bright yellow, cheeks against the eyes glossy black. Behind occiput on either side, a very robust pointed spine, and behind each eye a second conical eminence not amounting to a spine.

Prothorax metallic green with a golden reflex and patchy pruinescence, especially on the posterior lobe; beneath densely pruinosed.

Thorax brilliant metallic green with golden or coppery reflex, the dorsum including the antealar sinus, as far out as the humeral sutures chalky white with pruinescence. Laterally the sutures finely black, the postero-lateral one having 2 to 3 small yellow spots which are rather obscured by pruinescence in the adult, the ventroposterior border very narrowly yellow; beneath black obscured by pruinescence.

Legs black, coxae and trochanters pruinosed.

Wings uniformly rich golden yellow throughout from base to apex, with a satiny reflex; reticulation red; pterostigma 2 mm. in length, nearly three times as long as broad, outer border straight, inner border oblique pointed, posterior border rounded, colour deep blood-red; nodal index; $-\dfrac{34\text{–}29 \,|\, 31\text{–}33}{30\text{–}26 \,|\, 25\text{–}31}$; discoidal cell traversed 8–9 times; 10–14 cubital nervures; anal area simple; *Riii* arising slightly distad of the subnode; only a single row of cells in the space distad of the pterostigma.

Abdomen black, segments 1 to 4 metallic green with a bronzed or coppery reflex on 3 and 4; segments 8, 9 and 10 obscurely metallic green, not pruinosed; beneath black, pruinosed on segment 1 and 8.

Anal appendages black; superiors rather longer than segment 10, forcipate, curving in gradually to meet at apices, broad at base, then subcylindrical and finally compressed and a little expanded at apices which are obtuse. Inferiors about three-fourths the length of superiors, broad at base then cylindrical and tapering to apex which is curled slightly inward and ends in a fine point.

Distribution. Kalaw, Chin Hills, Burma. Type in the author's collection. This very beautiful insect appears to be closely related to *M earnshawi* by the pruinescence on dorsum of thorax and the colour of the wings ; it is distinguished from the latter by the larger size, the much larger pterostigma, the pruinosed spot on vertex and the relatively longer abdomen. It appears to link up the Oriental with the Palæarctic forms by the large pterostigma and the single row of cell following it, the former character being common to *M. costalis* and *M. pruinosa.* Female unknown.

Genus MATRONA, Selys (1853).

Matrona Selys, Syn. Cal. p. 17 (1853) ; Id. Mon. Cal. p. 32 (1854) ; Kirby, Cat. Odon. p. 100 (1890) ; Will. Proc. U. S. Nat. Mus. vol· xxviii, p. 170 (1904) ; Ris. Suppl. Ent. No. v, pp. 5-8 (1916) ; Munz, Mem. Amer. Ent. Soc. No. 3, p. 44 (1919).

Characters of the subfamily ; head wide, eyes widely separated and globular; epistome flat, frons low ; thorax robust ; legs of great length, slim, numerous fine spines ; abdomen of great length, slim, cylindrical, depressed at end segments ; body colouring brilliant metallic green ; wings long, very broad, apices rounded, reticulation very close, especially in the anal field, opaque in both sexes ; pterostigma absent in the male but a false, reticulated creamy white one in all wings of the female ; median (basal) space reticulated with 2 rows of cells ; discoidal cell traversed by many nervures, equal in length to median space ; numerous cubital nervures ; anal area complex, *IA* bifurcated shortly after its origin and sending a branch basad ; great numbers of intercalated nervures ; *Riii* arising slightly or well proximad of the subnode ; *Rii* not confluent with the radius after its origin ; node situated nearer base of wing than to apex.

Larva very similar to that of *N. chinensis*. Genotype *M. basilaris basilaris* Selys.

Distribution. Assam, Burma, Siam, Tonkin, Hainan, Annam and North and South China. Breeds in montane streams, habits, of the imago closely similar to those of *Calopteryx* to which the genus is related. Great variability is exhibited in forms from different localities, so that it would appear that there are but one or two species with a number of subspecies or races. One species and one subspecies are known from within Indian limits.

Matrona basilaris basilaris Selys (1853).

Matrona basilaris Selys, Syn. Cal. p. 17 (1853) ; Id. Mon. Cal. p. 33 (1854); Kirby, Cat. Odon. p. 100 (1890) ; Laid. Rec. Ind. Mus. vol. xiii, pp. 28-29 (1917) ; Selys, Cpts. Rend. Soc. Ent. Belg. vii, p. 5 (sep) (1888); MacLach. Ann. Mag. Nat. Hist. (6) 17, p. 370 (1896) ; Kirby, ibid. (7) 5, p. 536 (1900) ; Mart. *Mission Pavie*, p. 15 (1904) ; Bart. Ann. Mus. Zool. Acad. St. Pet. 17, p. 304 (1913) ; Ris. Suppl. Ent. No. v, p. 6 (1916).

Calopteryx basilaris Walk. List. Ins. Neur. B. M. iv, p. 601 (1853).

Male. Abdomen 42-55 mm. Hindwing 36-42 mm.

Head : labium black, the lateral lobes paler or brownish labrum and anteclypeus steely blue ; postclypeus brilliant bluish green metallic, rest of head dark green metallic ; antennae black ; eyes dark brown above, paler below.

Prothorax and thorax metallic emerald green with a bluish reflex on dorsum, the humeral and antero-lateral sutures black, the postero-lateral suture and the posterior ventral border of metepimeron bright yellow as also the underneath of thorax which is spotted with black. (In a male from Tonkin the underneath of thorax and postero-lateral suture are entirely black but there is a longish streak bordering the lower part of metepimeron yellow).

Wings rounded at apices, very broad, varying from a dark brown to blackish steely-blue according to age, the outer fifth of forewings comparatively hyaline but the nervures in this part all framed in opaque brown ; reticulation and nervures including costa black but the transverse nervures for a variable distance from base, usually up to a short distance distad of the node bluish white (This part of the wing viewed horizontally looks quite milky or bluish white) ; nodal index, $\frac{150\text{–}63|60\text{–}148}{138\text{–}58|59\text{–}145}$; discoidal cell traversed 18 to 25 times ; 26–28 cubital nervures ; *Riii* arising well proximad of the subnode ; basal (median) space traversed by 2 rows of cells, often in a network or with 10–12 traversing nervures ; anal area complex, filled with a very close network of nervures ; the underside of wings similar but differing by the shorter extent of bluish-white transverse nervures, which usually do not extend as far as the node.

Abdomen brilliant emerald metallic green on dorsum, black below.

Anal appendages black ; superiors thick at base, then subcylindrical, finally abruptly expanded and angulated inward at a little beyond their middle, apices blunt, outer border with 3 to 5 coarse spines ; inferiors about two-thirds the length of superiors, tumid at base, then cylindrical as far as apex which is hooked slightly in.

Legs of great length, finely spined, black, distal ends of hind femora brown.

Female. Abdomen 50–54 mm. Hindwing 44–46 mm.

Differs in several respects from the male as follows,—labium, bases of mandibles, outer sides of second segment of antennae and labrum bright yellow, the latter bordered with black and with a basal line and medio-basal point of the same colour. The yellow on sides of thorax of greater extent and the coxae and trochanters spotted with the same colour ; underside of thorax almost entirely yellow ; abdomen with the sides of segments 8 to 10 yellowish brown and the whole dorsum rather dull brown, segment 1 slightly metallic ; segment 10 with a well developed dorsal keel ending in a robust apical spine, and with a small tubercle surmounted with minute teeth on either side as in *Vestalis*. Anal appendages short, pointed, brown. Wings uniform dull dark brown, the bluish-white transverse nervures barely evident, the apices of forewings much as in the male ; in all wings a moderately large creamy white pterostigma traversed by a variable number of nervures (In a specimen from the Chin Hills, this varies from 2·75 to 3 mm. in length but in others it may be as large as 3·5 mm.) The milky-white or bluish-white transverse reticulation is also very variable, being hardly evident in some but as well marked as in the male in others.

Vulvar scale robust, yellowish or pale brown, extending nearly to end of abdomen.

Distribution. The type, a male in the British Museum, is from Sylhet but the species extends as far as Formosa and Shanghai. It has also been reported from Tibet, Burma, Chin Hills, Hainan and Tonkin.

Matrona basilaris nigripectus, Selys (1879).

Matrona basilaris, race *nigripectus* Selys, Bull. Acad. Belg. (2) xlvii. p. 355 (1879) ; Kirby, Cat. Odon. p. 100 (1890) ; Will. Proc. U. S. Nat. Mus. vol. xxviii, p. 187 (1904) ; Ris. Suppl. Ent. No. V, p. 7 (1916) ; Laid. Rec. Ind. Mus. vol. xiii, p. 28 and 29 (1917) ; Fras. ibid. vol. xvi, pp. 463-464, Pl. xxxv, fig. 1 and Pl. xxxvii, fig. 1 (1919).

Male. Abdomen 52–54 mm. Hindwing 38–40 mm.

Closely similar to *M. basilaris* but differing in several important characters, so that it seems preferable to treat it as a distinct species. Mr. Bainbrigge Fletcher has sent me a fine series from Shillong, in the Khasia Hills, Assam from where the type came, and a comparison of these with *basilaris* reveals the following differences,—Wings uniformly dark as far as the apices including the forewing ; in some adults the whole wing is of a magnificent steely dark bronzed or dark bluish metallic, the pleating of the wings showing this off to fine advantage ; the bluish-white nervures on the basal half of the wings are not nearly as pronounced as in *basilaris* ; the pterostigma in the female is considerably smaller and more variable, forewing 1·75 to 2 mm. hindwing 0·75 to 1·25 mm ; labium with lateral lobes dark and middle lobe entirely black ; labrum of female with a small spot of yellow on either side, otherwise black ; underside of thorax entirely black, as is also the postero-lateral suture and that part of the metepimeron which is yellow in *basilaris* ; abdomen of male a much more brilliant metallic emerald green. Female. Abdomen 43–53 mm. Hindwing 39–45 mm.

Type, a male in the Selysian collection.

Distribution. Khasia Hills, Assam and Upper Burma for which latter place Selys gives,—Pueopoli, in June, and Leito, in September. I am indebted to Mr. Bainbrigge Fletcher for the following notes,—' Common in Shillong throughout August, sexes in about equal numbers. A female was seen ovipositing in lower Trout Lake at the Fruit Gardens. Flapping along, settling on reeds and grasses. Sat on stem well above water and palpated it with ovipositor. Always as a rule found along streams, so this was rather remarkable, as the lake is so open (but has three streams flowing through it). Another female seen ovipositing below water level, abdomen about two-thirds below water. Bases of wings of males bluish grey, very noticeable in flight. A male seen sitting on a patch of damp sand at edge of stream, a female passed over and the male elevated the end of abdomen like a Pierid and half opened its wings at the same time but female took no notice and flew off and settled on a twig. The male then followed and settled on a twig near her, but nothing occurred. Two males were seen sporting over stream, flying up and down for a distance of about 20 yards, doing this for a long time. Occurs usually over tiny swift streams, usually clear pebbly streams, never over stagnant water except as mentioned above. Flies for only a short distance as a rule.' Thus the habits are very similar to those of *Calopteryx* to which genus these insects are closely related. The latest date on which the insect was seen by Mr. Fletcher was 18th October.

Subfamily CALIPHINAE subfam. nov.

Head transversely elongate; eyes hemispherical, tumid behind; occiput strongly ridged at its hinder border; labium notched deeply and narrowly for about one-third its length, lateral lobes shorter than middle lobe; face sloping to vertex; epistome not projecting.

Thorax robust, elongate, mesothoracic triangle absent; abdomen cylindrical, comparatively short, but longer than wings in both sexes; legs long, hind femora extending to beyond middle of segment 2, slim, spines long and hairlike. Wings long and narrow, apices rounded, reticulation moderately close, tetragonal in type; petiolation marked, extending nearly to level of arc; discoidal cell elongate, convex costalward, broadening gradually distad, outer end oblique, about half the length of median space which is entire; antenodal nervures numerous, costal and subcostal series coinciding, no primary antenodals; arc situated between the 4th and 5th or 6th and 7th antenodals, oblique, not angulated; sectors of arc arising from its middle, separated at origin; *Rii* shortly after its origin confluent for a long distance with the radius, especially in the hindwing; I*Riii* arising from this confluence; *Cuii* and *Riv*+ *v* forked, the latter pectinate; no intercalated sectors between *Cuii* and *IA* and only a single row of cells between the latter and hinder border of wing, so that the anal field scarcely exists and is very simple; intercalated sectors between *MA* and *Cuii* and between the remaining principal sectors at apical half of wing; node situate well proximad of middle of wing; pterostigma present in all wings of both sexes. Anal appendages closely resembling those of the *Agrioninæ* but the inferiors deeply bifurcate at apex; segment 10 not keeled; ovipositor robust.

Distribution. Tibet, Soth-western China, Bengal, Nepal and Assam.

Genus CALIPHAEA Selys (1859).

Caliphaea Selys, Add. Syn. Cal. Bull. Acad. Belg. (2) vii, p. 439 (1859); Will. Proc. U. S. Nat. Mus. vol. xxviii, p. 167 (1904); Laid. Rec. Ind. Mus. vol. xiii, p. 30 (1917); Munz. Mem. Amer. Ent. Soc. No. 3, p. 46 (1919); Kirby, Cat. Odon. p. 108 (1890).

Notholestes McLach. Ent. Month. Mag. xxiv, p. 31 (1887); Kirby, Cat. Odon. p. 111. (1890); McLach. Ann. Mag. Nat. His. (6), No. 71, xlvi (1896).

Characters of the subfamily; wings hyaline, tinted in adults; pterostigma about twice as long as broad, oblique at both ends; *Riii* arising far distad of the subnode; cubital nervures numerous but far less than in the *Agrioninae*, usually 4 to 6 in number; discoidal cell traversed once in all wings; 1 or 2 intercalated sectors between *Cuii* and *MA* but none between *Cuii* and *IA*.

Distribution. That of the subfamily. The position of the genus is obscure and must remain so until the larva has been discovered. On the whole I am disposed to place it near the *Agrioninae* on account of its metallic colouring, the shape of the labium and anal appendages, the confluence of *Rii* with the radius and the short pterostigma. On the other hand, the extremely simple anal field, the extraordinary long petiolation of the wings and the comparatively short abdomen are all foreign to the *Agrioninae* and seem to indicate a relationship with the genus *Dicterias*, a relationship which is however more apparent than real. We are faced with the problem as to whether this insect is an early offshoot of the main stem of the *Agrioninae* or a more modern insect which has undergone great reduction in the breadth of the wings. It is to be noted that the archaic primary antenodal nervure are no longer apparent.

Caliphaea confusa Selys (1859).

Caliphaea confusa Selys, Add. Syn. Cal. Bull. Acad. Belg. (2) vii, p. 440 (1859) ; Cat. Odon. p. 108 (1890) ; Laid. Rec. Ind. Mus. vol. xiii, pp. 30-31 (1917).

Notholestes elwesii McLach. Ent. Month. Mag. xxiv, p. 32 (1887) ; Kirby, Cat. Odon. p. 111 (1890) ; McLach. Ent. Month. Mag. (6) xvii, p. 371 (1896) ; Laid. Rec. Ind. Mus. vol. xiii, p. 30 (1917).

Caliphaea consimilis McLach. Ann. Mag. Nat. Hist. (6) No. 71, xlvi. (1896).

Male. Abdomen 36-40 mm. Hindwing 30-32 mm.

Head : labium black ; labrum brilliant metallic coppery ; clypeus brilliant metallic coppery with a golden or green reflex ; bases of mandibles, adjacent portions of cheeks and second segment of antennae bright yellow ; rest of head dark blackish brown with an obscure coppery glow (Teneral forms have the upper surface of head metallic green or peacock blue). Eyes brown above, paler olivaceous below.

Prothorax and thorax metallic coppery green with a crimson or gold reflex in some lights (metallic emerald green in tenerals), the sides along ventral border, and the whole of metepimeron save a small triangular area at its middle bright yellow ; beneath thorax yellow. Middorsal carina and the humeral and anterolateral sutures narrowly black.

Legs black, coxae and trochanters bright yellow.

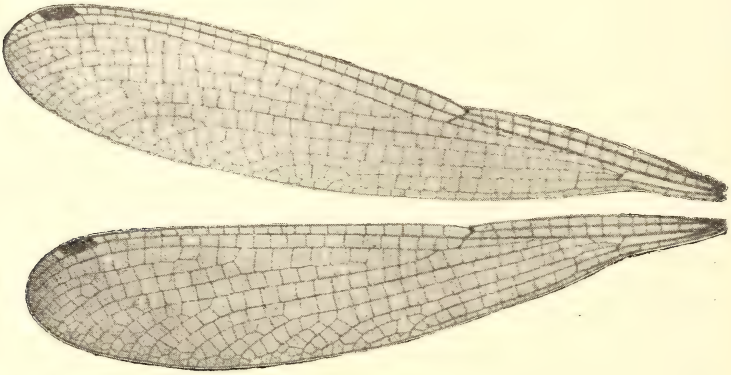


FIG. 2.
Wings of *Caliphaea confusa* Selys. ♂ (× 3)

Wings uniformly pale chlorine yellow, hyaline (untinted in tenerals) ; pterostigma reddish brown, covering 1½ to 2 cells (pale brown in tenerals) ; venation as for the genus ; the second basal antenodal often incomplete ; nodal index— $\frac{29-16 \mid 15-28}{27-14 \mid 12-26}$, $\frac{28-17 \mid 17-28}{25-15 \mid 14-25}$.

Abdomen dull coppery metallic in adults, brilliant metallic emerald green in tenerals ; segments 8 to 10 pruinosed white on dorsum in the adult, black beneath.

Anal appendages black ; superiors curving in forcipate-like to nearly meet at apices, outer borders coarsely spined, tumid at base as seen from the side, then subcylindrical and with a well-marked keel on dorsum extending nearly from base to apex which is markedly broadened and rounded. Inferior appendages about three-fourths the length of superiors, flattened, tapering slightly to apex which is angulated in at a right angle as a robust pointed spine ; on the inner border a second and equally robust spine situated as far from apex as its own length so that the apex of appendage appears to be deeply bifurcate.

Female. Abdomen 34–37 mm. Hindwing 31-32 mm.

The female has not hitherto been described but is exactly similar to the male allowing for sexual differences ; the nodal index is usually slightly higher and the majority of specimens taken are more metallic emerald green than coppery, this only because adults appear to be scarce. Anal appendages short, conical, pointed, brown.

Vulvar scale very robust, extending to extreme end of abdomen, brown.

Distribution. That of the genus. Mr. Bainbrigge Fletcher has found this species common in Shillong, 6,000 ft. during May and June, and I have found it in colonies in the Darjeeling district at 3,000–5,000 ft. in May. It breeds in small brooks meandering through marshes on steep, heavily wooded hill-sides and the adults are found perched on ferns or grasses overhanging the stream, or if teneral, hiding up in scrub jungle near by. The shallowness of the brooks and the dense grass growing in their bottom made it impossible to dredge up any larvae although I spent some time in ineffectual attempts to discover them. McLachlan's *consimilis* differs only by having two traversing nervures to the discoidal cells and their tenerality.

(*To be continued.*)

SOME NOTES ON THE BIRDS BREEDING ROUND QUETTA

BY

MAJOR C. H. WILLIAMS, M.B.O.U. AND C. E. WILLIAMS

(*With two plates*)

Quetta is as everybody knows a Military Station of considerable importance, situated in Baluchistan at an elevation of 5,535′. Quetta itself is a quasi-valley with mountains all round with narrow passes leading from them, whilst the highest peak is in the Zarghum Range, some 11,738′.

The general aspect of the Valley is barren and arid to a degree, consisting of, 'recent and sub-recent terrestrial deposits, cut up by dry water-courses, while the surrounding hills are of cretaceous rocks which have been subject to a great deal of lateral pressure and local disturbances.' Erosion, also, has played a prominent part in the rugged and barren nature of these hills.

The Quetta Valley is not well watered in a natural way, and hence vegetation is of the scantiest. On the highest slopes Junipers are fairly common, lower down a species of wild cherry, almond and eglantine, are to be found mixed with a stunted type of acacia and wild sage which becomes more common as the level of the main valley is reached. There are also other shrubs and bushes but these latter play no part in the ornithology of this land. In the lower valleys fairly large trees are to be met with, the chief of which are *Zizyphus jujuba* and *Pistacia cubulica.* In the Valley there are also to be found many lowly shrubs such as the wild caper and Camel-thorn *Alhagi camelorum*, beside large trees such as the Mulberry, Apricot, and Afghan Willow.

The general aspect of Quetta, as before mentioned, is barren, except where by means of 'Karezes' water can be brought to the surface, when orchards, gardens and fields of wheat and maize flourish. These 'Karezes' are of very ancient origin; being a series of shafts connected by underground tunnels which drain the sub-soil water to the surface eventually. The first shaft of a 'Karez' is sunk at the foot of the hills, but no cultivation is carried on there as a 'Karez' is generally of great length before it becomes in any way effective.

Even in the hills where there are a few springs there is not much cultivation on account of the sandy nature of the soil, and the small volume of the springs.

In summer the heat is intense, especially towards the end of July when the shade temperature is sometimes as much as 110. Winter sees a contrast of a temperature in February of —10, with an icy-cold wind that blows over the snows from the north. This is a strange region to classify, it is not Tropical, nor Palæarctic, yet it cannot be termed Sub-Tropical or Sub-Palæarctic ; it is one of those glorious 'half-way houses', which have much to yield to the ardent collector as the following notes show.

1. **Corvus corax laurencei.** The Punjab Raven.

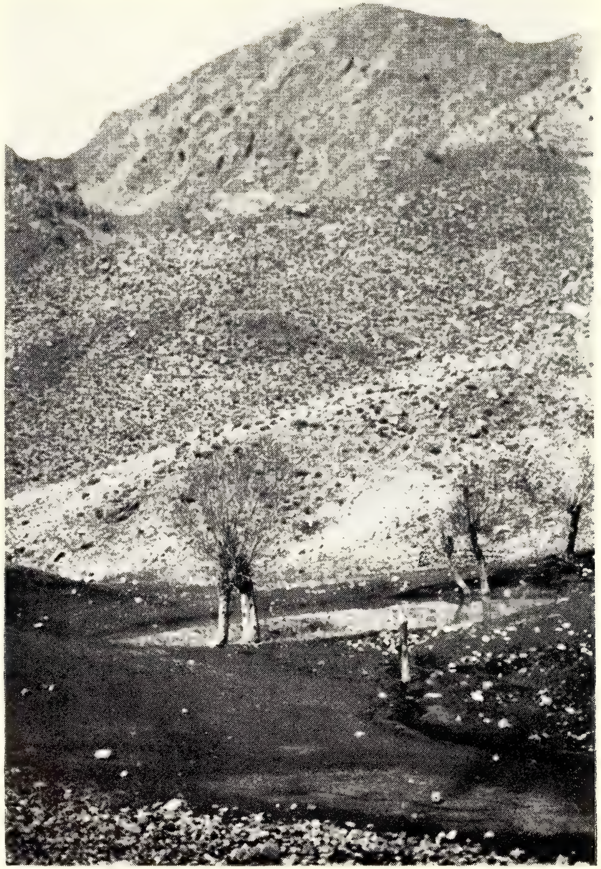
This bird is a common resident throughout the Quetta Valley haunting the Cantonments in winter, when their numbers are augmented by birds from the north. This Raven sometimes makes use of the deserted nests of the Magpie, a clutch of five eggs being taken on the 26th of March from such a nest, and sometimes it builds in the clefts in the numerous cliffs that are to be found in the hills.

2. **Pica pica bactriana.** The Kashmir Magpie.

A common breeder in the Quetta Valley, nesting in the Orchards during March and April. They sometimes lay as many as eight eggs.

3. **Pyrrhocorax pyrrhocorax.** The Red-billed Chough.

Although this bird is only a winter visitor to the Quetta Valley, a certain number breed in the hills to the north. On the 24th of May, while climbing up into the Marachak Reserve Forest, I saw two of these birds fly from a cave in

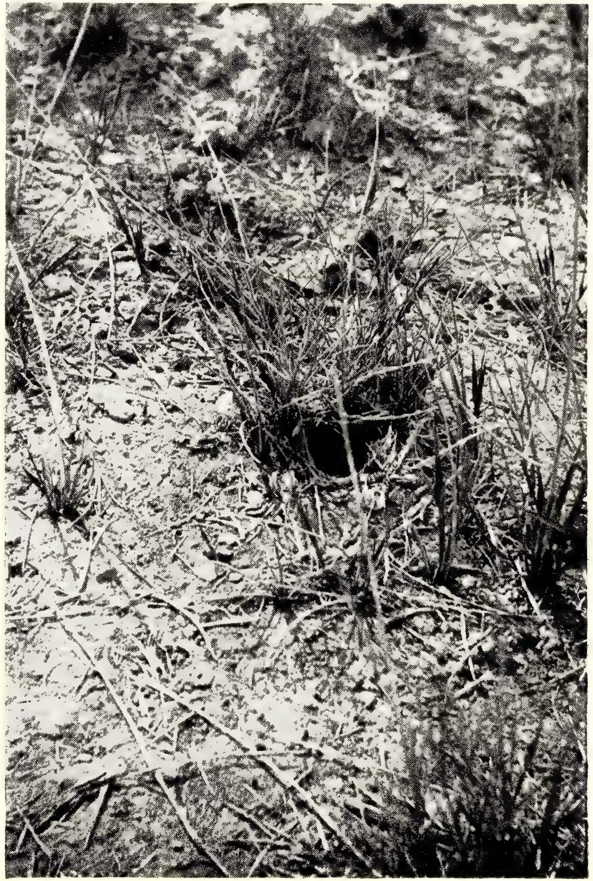


A SPRING IN THE TUCKATOO RANGE,
9,000 ft.

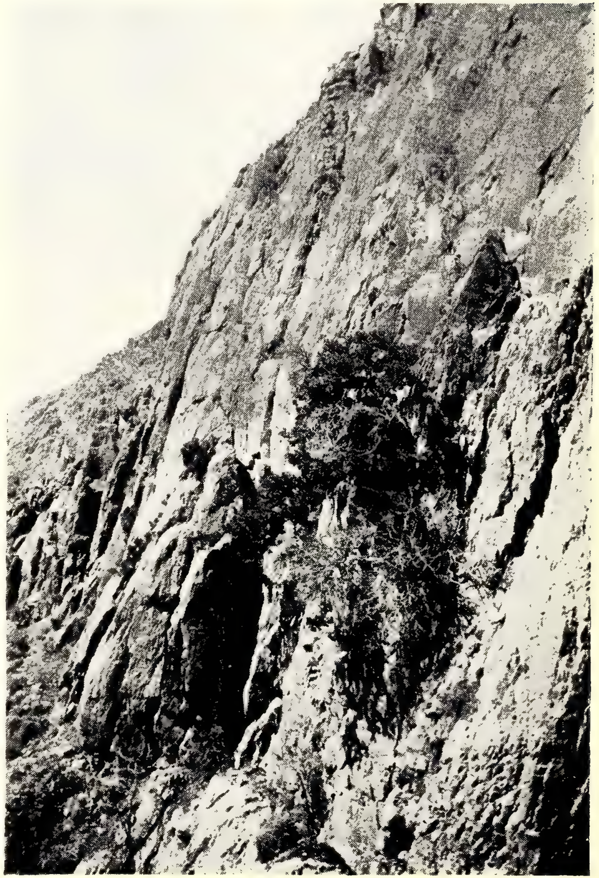
Haunts of the Chukor, Seesee, Desert Lark, Pied Chat, Orphean Warbler, White-throat, Rufous Shrike, etc. In the higher range in the background, Nuthatches, Kestrel, Golden Eagle, Bearded Vulture and Ravens occur.

LORA RIVER, LOOKING DOWNSTREAM.

Haunts of the Magpie, Sparrows, Bee-eaters, Pied and Bush Chats, Kingfishers, etc.



Nest and Eggs of Hume's Crested Lark (*Galerida cristata magna*).



Nest of the Himalayan Golden Eagle (*Aquila chrysaetus daphanæ*) in a Juniper tree on a cliff face.

the cliff face, and watching, saw them return. With excited cries they flew to the upper corner, so feeling certain that a nest was there, I climbed up in an endeavour to find it. The ascent was more difficult than it had appeared to be. The cliff, after a rise of about 150 feet, barely receded 15 feet. The cave was about 4 feet deep and about 30 feet high, domed and backed with crumbling lime-stone, and up in the corner where the arch and wall met, in a small cleft was a fair sized nest of sticks and twigs, in which was one young nearly ready to fly. Unfortunately it was impossible to reach this nest without a ladder and so it had to be left. On the ground below were two dead young, the bases of their primaries still in the sheath, covered with vicious little red ants, and as I could not manage to get rid of these latter I had to leave the bodies where they were. A second nest was in the same cliff face of the 'Marachak Tangi', and was equally impossible to get at on account of the nature of the cliff and the position of the cave. Yet anoter nest was found in June in a 'Tangi' at Ziarat. This bird along with the Raven seem to be resident here. This record extends the breeding range as hitherto recorded. The elevation was about 9,000 feet.

4. **Sitta neumayer tephronota**. The Turkestan Rock-Nuthatch.

This Nuthatch is to be met almost anywhere in the hills around Quetta, and knowledge of its presence is forced on one by its chattering, though pleasing call. It is a lively little bird and extraordinarily active on its legs, climbing almost any rock face, however perpendicular and precipitous, in search of food.

The first nest I found, was on the 21st of April and it held a clutch of four eggs, of which two were unfortunately broken in getting them out. Many nests subsequently found, were either deserted, with young or only partly built. A few nests had dead birds in them. The breeding season is an early one, the first nest being found towards the latter part of February, whilst the last nest was taken on the 6th of June.

The nests are all built inside small clefts of the rocks, but outside the actual hole in which the nests are placed, the birds build most extraordinary structures of clay, shaped much like a woman's breast. In some cases these are comparatively small, a foot in diameter and sticking out of the face of the cliff for about six inches. The point of this mud entrance is sometimes prolonged in the shape of a cone, at the end of which is the actual entrance hole, being about one and a half inches in diameter. In other instances the clay portion may cover as much as three square feet and in these instance the breast work is generally built over the entrance to a cleft which is rather larger than usual.

The nest itself is made of fur, often that of the Mouse Hare, to which is added a thick lining of feathers. Feathers and other bright objects are also sometimes stuck into the clay outside, which when dry and set, is very hard.

The eggs differ from those of most Nuthatches in being larger, much more glossy and more sparsely and boldly spotted with red.

5. **Trochalopterum lineatum ziaratensis**. The Baluchistan Streaked Laughing Thrush.

This bird is fairly common and resident in the higher bush-covered slopes of the hills, only moving down when the cold is more intense than usual, when it comes right into the Quetta gardens. It breeds freely at Ziarat and on the Zurghum slopes.

I found a new nest on the 17th of May, in a fair sized leafy bush at the head of the 'Marachak Tangi', and on visiting it a week later, I shot the bird off the nest and secured a clutch of four fresh eggs. The nest was a massive structure of fibrous material and bulbous plant stems, lined with fine grass stems and hair, and placed about 4 ft. high, in a green thornless bush. The diameter of the inside cup was nearly 3 inches, and its depth about 2 inches. The thickness of the walls of the nest was approximately 2 inches. The eggs are similar to those of the better known race *T. l. lineatum*, fairly broad ovals, very glossy and close in texture, and in colour a beautiful sea-green when fresh. They fade considerably after being blown.

6. **Molpastes leucotis**. The White-eared Bulbul.

The only member of its order in the Quetta Valley; resident and fairly common, frequenting gardens and orchards. It commences nesting in April and continues till mid-June, laying three comparatively small eggs of a pale pink colour, marked but not boldly, with reddish-brown, with secondary markings of pale lilac or inky-purple.

7. **Hippolais rama.** Sykes' Tree Warbler.

This little warbler, first discovered to be a common breeding bird about Quetta by General Betham in 1900, is just as common in the present day. Practically every orchard and every garden of the Quetta Valley has a certain number of these little birds breeding in them, and wherever there are any tamarisk or rose bushes, it is sure to be found.

The breeding season starts about the end of April and closes mid-June. During this period these birds are gregarious, and once a colony is located, many nests may be found in a small area, a couple of nests are often in a single bush. The nest is a neat compact little cup on a framework of grass. The sides, nearly an inch thick, are built of grass, bits of rotten bark, hair, string or any other soft material; the inside is lined with fine grass stems, feathers and cotton. The diameter of the inside cup is nearly 2 inches and the depth is about an inch and a half.

The eggs vary greatly both in size and colour. Some are pale-lilac whilst others are whitish. In some the markings are spots and small blotches of black with secondary markings of pale inky-grey, while in others they are bold blotches, streaks, and hair-like lines of the same colour, with the same secondary markings.

Taken as a whole the eggs are remarkably handsome. Four is the usual clutch, though on one occasion a clutch of five was found.

8. **Hippolais languida.** Upcher's Warbler.

Though very little has hitherto been recorded about this warbler or its interesting habits, in Baluchistan I have found it far from uncommon upon the stunted, bush covered, stony hillsides of the Quetta Valley. It is a rather silent bird and in consequence its presence is often overlooked or if seen, it is mistaken for the previous bird. It is a much later breeder than any of the other warblers, the earliest date a nest was found was the 15th of May, and I was very unfortunate in being able to find but four nests which contained eggs. One of these contained an addled egg with two young ones; another egg was taken from a nest which was deserted after it was first found, no more eggs being laid, and the other two nests contained two, and three eggs respectively.

The birds are very shy, and we found that they deserted their nests on the slightest provocation whether the eggs were laid or not.

The nest itself is a neat little cup made principally with grass, the lining being of fine grass stems, whilst the outside is well plastered and matted with cobweb. The nest is generally placed in small close-growing branches of stunted thorny bushes.

The eggs are moderately long ovals slightly pointed at one end, the ground colour is a pale pinkish-purple, sparsely marked with fairly bold blotches and dots of black. The shell is fine and very fragile and slightly glossy.

9. **Sylvia hortensis crassirostris.** The Eastern Orphean Warbler.

The bird, as far as my observations go, appears to be confined to certain localities only in the hills, where there is a fair amount of bush and not too far from water, though they are sometimes met with in very arid regions.

Generally speaking in the better watered and bushed localities these birds are fairly common. When I first noticed these birds, I was not certain to what species they belonged, so to make certain I shot one as it flew out of a bush, and on examination, saw that I had obtained a specimen of a *Sylvia hortensis crassirostris*. I at once searched for its nest, which was found near the top of the bush from which it had flown. It contained three incubated eggs.

The earliest date on which a nest was found was the 9th of May after which many more nests were found, the last being taken on the 9th of June. The nest is a neat cup of grass bents and dead leaves of bulbous plants, and is well lined with fine grass stems.

They are generally built among the small branches of wild Sage bushes and are secured to them with cobwebs.

In shape the eggs are long ovals, slightly compressed at one end. The texture of the shell is close with little or no gloss.

The colour is a very pale bluish-grey and even this is only noticeable when the eggs are placed against or amongst really white eggs. The markings which are mostly at the large end with a few spots and specks scattered over the rest of the egg, are olive and purplish-brown, with secondary markings of pale lilac.

10. **Sylvia althæa.** Hume's Lesser Whitethroat.

In the spring of this year (1925), I noticed a large number of warblers, which though similar to the Orphean, were smaller, I took them to be Whitethroats, but did not shoot any. On the 10th of May, however, three nests were found and a bird shot off one of them, which on identification proved to be Hume's Lesser Whitethroat. Nests were found up to the 7th June.

The nests are fairly neat structures, cup-shaped and made of strips of leaves of bulbous plants and lined with fine grass stems and hair.

They are placed either in wild Sage or in low thorny bushes, never in a fork, but always suspended between the upright and growing branches. When disturbed off the nest the bird skulks away. A new nest is often deserted if looked at.

The eggs three or four in number, are fairly broad ovals with a slight gloss but not very close texture. The ground colour is a pale grey, white or creamy, marked and streaked with brown and pale olive, with secondary markings of inky-purple. The markings are scattered over the egg but have a tendency to form a cap or zone at the large end. In some eggs the markings are small, while in others they are bold and handsome.

This bird has rather a low, pleasing song when heard from a distance ; but when close there is a harsh rattle discernible through its softer tones.

11. **Acanthopneuste nitidus nitidus.** The Green Willow Warbler.

A couple of seasons ago a family party of these little Warblers were found in a small, fairly well wooded valley in the 'Marachak Reserve' feeding young fledglings that could just fly. Though a thorough search was made no nest could be found. This season (1928) during the latter part of May, a nest with three fresh eggs was found in the same locality, the parent bird being flushed and identified.

The nest was a large loosely put-together ball of grass and dry moss and lined with fine grass stems and hair, and placed amongst the jumbled and bush-overgrown roots of a Juniper.

The three eggs were fresh, and the yolks showed clearly through them, imparting a beautiful pale pink colour to the eggs. When blown they were pure white, slightly glossy, and of none too close a texture.

The average measurement of the three eggs is 16·7 mm. by 12·3 mm.

12. **Scotocerca inquieta striata.** The Streaked Scrub Warbler.

This little Warbler is common all round Quetta and affects the low thorny shrub that is to be found both in the valleys and on the hillsides in Summer. Its call is like the squeaking of mice, and it is a very restless little bird, continually moving about and jerking its tail over its head.

Several nests found were either deserted, or contained dead young. They are well known and no description is necessary, but it is interesting to note that in one nest found on the 8th of June, there were three Warbler's and one Cuckoo's egg, and in another nest which was deserted, contained three of the foster's eggs (one broken) and a broken Cuckoo's egg ; in a third found on 24th of May three foster's and two Cuckoos, in a fourth nest found on the 31st of May there was a well fledged young Cuckoo being fed by the little Warblers, this was taken and kept in captivity for two months when it died. The Cuckoo in each case was *Cuculus canorus telephonus.*

13. **Lanius vittatus.** The Bay-backed Shrike.

In Summer this Shrike is fairly common in the hills around Quetta but only frequents certain tracts of the hillsides and does not encroach on the haunts of *Lanius phœnicuroides.*

The nests are placed in thorny trees and are of the usual type.

14. **Lanius cristatus phœnicuroides.** The Rufous Shrike.

This bird is common in certain localities in the hills but not in the Quetta Valley itself. It frequents open hillsides, scantily covered with bushes, and its presence is always known by its noisy call.

The nest is a well built one, a frame work of sticks and twigs the walls being built of grass, fibre and fine flexible twigs, well lined with soft grass It is placed in thorny bushes at no great height from the ground.

The eggs are broad ovals, close in texture and fairly glossy. In colour they are (1) a beautiful salmon pink, (2) a pale stony-drab. The markings form an irregular zone at the large end, and are pale brown with underlining clouds of inky-purple.

The average measurement of 20 eggs is 22·8 mm. by 16·2 mm. As a rule four to five eggs are laid but sometimes as many as six. The birds commence to lay in April and eggs may be found as late as the middle of June.

15. **Lanius schach erythronotus.** The Rufous-backed Shrike.

This Shrike is very plentiful in the Quetta Valley and is to be found in every orchard and garden. Its nesting habits are too well known and need not be described. One thing however is deserving of mention.

There is a heavy toll of Sparrows taken by the Shrikes, just about the time when their own young and the fledgling Sparrows are ready to fly. The method by which the young Sparrows are done to death by the parent Shrikes is neither quick nor businesslike, and the unfortunate victims are submitted to much needless torture before being killed. This is how the ghastly work is done : a young Sparrow on being caught is invariably held pinned to the ground by the old Shrike, and the fledgling Shrikes collect round in a close cordon, and a big din is set up to keep off the frantic parents of the victim and while this is going on, the dreadful work proceeds.

The murderous Shrikes set to work and inflict a succession of sharp pecks at the Sparrow's head, and in its hopeless state it struggles and squeaks in despair and terror. This bloody orgy brings forth a chorus of approval from the feathered butchers, and the brutal onslaught is continued till the Sparrow maimed, exhausted and spent, eventually succumbs. One would think that the ravenous appetite of the young Shrikes would be glutted on the defunct fledgling, but such is not the case, and it is a surprising fact that only the brain and odd parts here and there are eaten, the rest being left to find its end as a dainty morsel for some scavenger bird.

16. **Muscicapa striata neumanni.** The Eastern Spotted Flycatcher.

This is the only Flycatcher that I have found breeding in the Quetta Valley and it must be considered a rare bird. There is a specimen in the McMahon Museum obtained at Nuskhi in May, and I have seen a few birds in April and May in the hills around Quetta where there are a few large trees and water.

On the 18th of May, 1926, a nest was found built in a crevice in a ' Tangi ' from which three eggs were obtained, the bird being identified as the Eastern Flycatcher. The ' Tangi ' was at an elevation of some 6,000 feet the nest was built of grass roots and dried moss lined with fine grass and moss roots.

The three eggs are moderate ovals slightly glossy and close in texture. In colour they are a pale green marked with brownish-red. The markings being spread over the whole surface, giving the egg a darker greenish appearance. The three eggs average 19·28 mm. by 14·0 mm.

17. **Saxicolca caprata bicolor.** The Common Pied Bush Chat.

This is a very common Summer visitor in the Quetta Valley arriving late in Spring and frequenting the open spaces near orchards. The breeding season is late, no birds nesting till May, although the male bird, who helps build the nest, is in full song before nesting operations commence. They continue to lay till mid-June.

The nests are built in various places, holes in walls, under bushes, in the banks of nullahs, and even in the holes in the ' karezes '.

They are merely pads of wool and horse-hair, intermixed with fibrous materials and lined with horse-hair.

The eggs three to five in number, are broad ovals and slightly glossy. In colour they are pale greenish-blue marked with brownish-red, generally in the form of a zone at the large end.

They average 17·2 mm. by 13·8 mm.

18. **Œnanthe picata.** The Pied Chat.

This Chat is very common in the Quetta Valley, and is to be found wherever there are banks, fallow fields, broken and tumbled-down buildings. It is also met with in the hills up to about 8,000 feet.

In the breeding season April to June the cock bird has a fine song and shows off his black and white plumage to advantage while dancing before his mate.

The nests are pads, or shallow saucers, with no definite cup, of various materials, such as grass feathers, wool tow, and bits of rag, lined with hair and wool. They are placed in holes in banks, walls, houses, under rocks and in piles of dried silt at the mouths of ' karezes '.

The eggs, four to six in number, are pale blue, marked with reddish-brown at the large end. In shape they are broad ovals and have a slight gloss. 50 eggs average 20·7mm. by 16·02 mm.

19. **Œnanthe melanoleuca melanoleuca.** Barnes' Chat.

This Chat is by no means common in the Quetta Valley being found only in the dry low foot hills, at an elevation of about 6,000 feet, and its nests are very difficult to find, as it is a very shy bird.

One nest found in May, which was placed under a small heap of stones, was a shallow saucer of sticks, fibrous plant stems, grass and hair.

The eggs, five in number, are fairly broad ovals slightly glossy, and of a deeper blue than is usual in Chats' eggs. Marked chiefly at the large end in the form of a zone with brick-red spots. Average 20·5 mm. by 15·4 mm.

20. **Œnanthe isabellina.** The Isabelline Chat.

This is one of the very common birds of the Quetta Valley, arriving early in February and leaving in October. Though this bird is so common its nests are very difficult to find, till the young are hatched, when the excitement of the parent birds and the numerous foot marks near the nesting hole gives it away.

The site chosen for a nest is generally a Rat's or discarded Bee-eater's hole. When built in the latter it is fairly easy to dig out, but when in a Rat's hole the chances of ever reaching the nest is very remote owing to the numerous branch diversions in the burrow.

The nest is a shallow saucer made of wool, grass stems, tow, feathers and bits of string and rag, lined with hair and wool. The eggs are from four to five in number, broad ovals, pale blue in colour and moderately glossy. An occasional egg having a very few reddish-brown spots. The average of fourteen eggs is 21·9 mm. by 16·7 mm.

I have seen the nuptial display of various birds but that of this Chat is, I think the most remarkable. With drooping wings and outspread tail the male approaches the object of his affections, uttering the whole while a pleasant whistle. When within a foot or so of her, he rises about 18 inches off the ground and flutters in a rapid oscillating motion in front of her, only the black and white of his plumage being visible against the drab coloured earth. After this performance he alights near her and struts round with outspread wings and tail, singing gaily all the time. He then shoots up into the air, hovers and performs aerial stunts, pouring forth his song the while. Gradually his song becomes disjointed and he slowly desends to earth in a spiral motion, and on alighting, approaches his lady love with a hesitating run, both wings adroop and tail still outspread, chirping with satisfaction. All through this wonderful exhibition the female takes not the slightest notice but carelessly preens her feathers or feeds.

21. **Œnanthe deserti atrogularis.** Gould's Desert Chat.

In spring and Autumn this Chat is to be met with in fair numbers in the low foothills chiefly to the north-west and north of the Quetta Valley. A few pairs remain to breed in the Quetta Valley itself. The localities they frequent in the breeding season are in the stony wastes, which form the predominating feature of the foothills, here there are a few hardy shrubs and a sprinkling of Camel-thorn.

A nest found on the 15th of May, from which the bird was shot and identified, was built in a hole in the bank of a dry nullah, in the type of locality described. The nest was built of grass hair and wool, lined with hair and wool.

There were four eggs and they are a very pale blue, slightly glossy, with a few faint markings at the large end.

They average 206 mm. by 154 mm.

22. **Œnanthe zanthoprymna chrysopygia.** The Red-tailed Chat.

A rather rare bird breeding only in a few localities, and its nests are hard to find. The site generally chosen is a hollow in a cave or cliff face ; this cavity is filled with small flat pebbles and the sides of the nest are supported by a rampart of small flat stones, the nest itself being built of grass and lined with fine grass stems.

The eggs, four to five in number, are pale blue, slightly glossy and very sparingly marked with brick-red ; sometimes there are no markings at all.

The average size of eight eggs is 20·7 mm. by 15·9 mm.

The birds breed during April, May and June, my first clutch being taken on the 13th of April and the last clutch on the 16th of June.

22. **Phœnicurus ochrurus phœnicuroides.** The Kashmir Redstart.

A Summer visitor to the hills around Quetta, where it breeds. Two nests were found on the 7th of June 1925, in the 'Marachak Tangi' but were deserted before any eggs were laid as I had to put my hand in them to ascertain if there were any eggs or not, being unable to look into them.

On the 30th of May 1926, a nest was found in the same locality and two eggs were obtained and the parent bird secured.

The nest was built in a hole in a rock and was composed of dried moss, roots and very fine grass stems and a few feathers.

The eggs are a pale blue, fairly glossy and without markings.

The two eggs average 19·1 mm. by 13·9 mm.

23. **Monticola solitaria transcaspia.** Hartert's Blue Rock Thrush.

This Thrush is to be met with both in the hills to the north of Quetta, and on the road to Ziarat, in any localities where there is water, no matter how little, and where the surrounding country is extra rugged and boulder-strewn.

About the end of May I observed several pairs of these birds nesting, and also saw young birds being fed. A search soon revealed several nests, but when I visited them a week later they were all deserted.

On the 15th of June a nest with three fresh eggs was found in a narrow gorge, and the female was shot as she left the nest.

The nest was a deep cup of leaves, grass and dried bulbous plant stems, well lined with hair, and placed in a niche about 18 feet high.

The eggs are pale clear blue, two being unspotted and the third slightly so at the larger end with pale reddish-brown. In shape they are long ovals, minutely pitted, and having little or no gloss.

The average of the three eggs is 26·9 mm. by 19·4 mm.

24. **Erythrospiza githaginea crassirostris.** The Eastern Desert Finch.

This is a rare bird in the Quetta Valley but breeds freely in the Pishin Valley, making its nest among the rocks, and, I am informed, in the trenches where the vine is cultivated.

My first nest was found at Sheik Mundah, on the 14th of May, 1924, and two other nests have subsequently been taken in the Quetta Valley, (on the 25th of May, 1926), and the bird secured in both the latter instances.

As regards the first nest, as soon as the female flew off the nest, I knew that it was not a *R. obsoleta* which is so common round Quetta, and when the male bird came on the scene, my companion pointed out the difference. The pink breast of the male and the ashy hue of the female is an easy distinction from *R. obsoleta*, and the owners of the nest were, without a doubt a pair of *E. g. crassirostris*.

The first nest was in an old deserted building, placed between two laths going across a beam, and was a framework of thin sticks and twigs, lined with wool and hair. The other two were also built in a ruined building, a watch tower, and were placed in broken patches of the crumbling mud walls. The nests were of the same type.

The eggs, four in number are broad ovals, slightly glossy, and in colour a clear pale blue marked with a few black spots at the large end.

They average 18·3 mm. by 14·9 mm.

26. **Carduelis caniceps subulata.** The Central Asian Goldfinch.

This Goldfinch is a local migrant frequenting the Quetta Valley in the Spring and Autumn, and retiring to the hills in Summer to breed. A few pairs, however, remain to breed in Quetta itself, as two pairs of adult birds were constantly seen in, or in the vicinity of our garden, and in the late Spring were seen feeding young, though we had not the luck to locate the nest.

The nearest to Quetta where they breed with any degree of frequency, is the Takatu Range, above an altitude of 8,000 feet among the Juniper covered slopes of this and the neighbouring ranges.

All the summer I have seen birds there, and about the middle of September, when out shooting, large flocks of these Finches have come down to drink.

With the aid of a decoy bird, and a trap cage these Finches are easily trapped, and they take to capitivity very well, the song of the adult males being similar to that of a Canary, though the notes are not so liquid. When, however, heard from a distance it is quite pleasing. These Finches are regularly trapped during the migration flights, and find a ready market.

27. **Metaponia pusilla.** The Gold-fronted Finch.

This little Finch is also common in the hills, keeping to the rocky hillsides where a few small stunted bushes are scattered here and there. We have not found their nests, but while resting under some trees near the only spring of water in the hills, have seen family parties of seven birds or so come down to drink.

I am informed that they breed freely at Ziarat, but as we have not worked in that locality, we can record nothing further about them.

28. **Rhodospiza obsoleta.** Lichtenstein's Desert Finch.

Next to the Sparrow this is the commonest bird in the Quetta Valley in Summer, arriving in March and leaving in September, though a few birds remain throughout the Winter. Once the breeding season has started, its cheery call *Pink* ? *Pink* ? *Pink* ?, is heard everywhere in Cantonments, whilst its nests are to be found in nearly every tree, little or no attempt being made to conceal them from view.

The nests are placed at various heights, from three to fifteen feet from the ground, in forks of trees along roadsides, and in gardens. It is a compact cup of wool, well felted in a slight framework of sticks and twigs. The breeding season is from April to July, the majority of birds having two broods.

The eggs of which we have a large series, vary greatly in size and shape, some being long narrow ovals and others broad ovals. The texture of the shell is close and fine and silghtly glossy. The clutches range from five to seven, those of five being most common.

The colour of the eggs is pale blue, and when fresh the yolk can be seen through the shell. The markings, which are confined to the larger end, either in zones or caps, consists of dark brown and black spots, scratches, and hair-like lines.

My largest egg is 22·8 mm. by 14·7 mm. and the smallest 18·8 mm. by 14·0 mm., whilst the average of 50 eggs is 19·2 mm. by 14·4 mm.

29. **Passer domesticus indicus.** The Indian House Sparrow.

Very common during the Summer, leaving the Quetta Valley towards the end of September. It nests in trees and holes in nullah banks, and only lives up to its name when found nesting among the rough thached roofs of Pathan villages.

30. **Passer montanus dilutus.** The Afghan Tree Sparrow.

This species too is one of the very common birds of the Quetta Valley in Summer, and a few remain during the Winter.

It keeps principally to the orchards and plantations, where it builds the usual shapeless nest of grass, rags, string, etc., in the thin branches of trees, and lays the usual type of egg.

31. **Emberiza stewarti.** The White-capped Bunting.

This Bunting is to be found on the open grass covered and scantily bushed plateaux where it is fairly common. Its call is similar to that of some Warblers, and I have often mistaken it for these.

Towards the end of May I observed several pairs of these birds with grass in their beaks, but failed to locate their nests. On the 15th of June while coming along a ridge after a day's nesting one of these Buntings flew up at my feet with a cry of alarm ; on looking down, I saw between a stone and a stump of grass, a deep cupshaped nest of grass and fibres, lined with horse-hair. The nest held three partially incubated eggs. The bird is a very close sitter, for my foot was about nine inches from the nest when it flew up, and I must have passed within a few feet of the nest the previous Sunday.

32. **Ptynoprogne obsoleta obsoleta.** The Pale Crag Martin.

This Martin is very common in certain localities in the hills and its nests are to be found under overhanging rocks and such like places, in the vicinity of which it keeps a constant beat in its flight to and fro.

The nest is a half cup of mud pellets, with a few grass stems intermixed and well lined with feathers. The whole is attached to the wall of a cave or rock close under the roof.

The eggs three to five in number (generally three), are of two types. In some they are white marked with fine spots forming a zone at the large end, of reddish-brown, or with fairly bold marks and spots of the same colour. In shape they are moderately broad ovals, with little or no gloss. In size they average 18·2 mm. by 13·3 mm.

33. **Hirunda rustica rustica.** The Common Swallow.

Very abundant all over the Quetta Valley, arriving in early Spring and leaving towards the end of October. Nearly every shop in Quetta, and the huts in the villages has a nest or two, but as these birds are supposed to bring good luck, the owners will not allow the nests to be taken.

34. **Hirundo fluvicola.** The Indian Cliff Swallow.

A clutch of three eggs of this Swallow were brought in from Mastung, by S/Sergt. A. T. Webster, I.A.S.C., who was only able to get at one nest. They were built under an overhanging ledge and were composed of mud lined with grass and feathers.

The eggs are moderate ovals, white faintly marked with pale brown. They average 18·3 mm. by 13·2 mm.

35. **Hirundo daurica rufula.** The European Striated Swallow.

This Swallow is the European form and not *nepalensis* ; the bird is large with a wing measurement of 122·5 mm. and the tail is 102 mm., the colour of the breast is chestnut and well defined. It affects certain localities and does not come near human habitations, keeping more to the river courses and valleys in the hills where they are only found in pairs.

The nests are retort-shaped, made of pellets of mud, fixed to the roof of a cave or under an overhanging rock. The needs of the nests are not nearly so long as those of *H. d. erythropygia*, but the nests are more liberally lined and padded with feathers.

The eggs are long ovals pure white with little or no gloss. The average of four eggs is 19·2 mm. by 14·0 mm.

36. **Anthus sordidus decaptus.** The Persian Rock Pipit.

This Pipit is very common on the hills around Quetta, but a search for its nests has ended in many disappointments.

It breeds in the latter half of April and in May, the nests are loose cups of grass lined with hair and fine grass stems, and placed under bushes or clumps of dried grass.

37. **Alæmon alaudipes pallida.** The Persian Desert Lark.

This Lark is to be met with fairly frequently in the stony wastes at the foot of the hills. It is rather a silent and confiding bird and does not take to wing as willingly as *G.c. magna*, preferring rather to run.

Round Quetta it breeds in the localities where it is found, making an untidy nest of grass, lined with finer grass and hair, with a few feathers intermixed, generally placed under a sheltering stone.

The eggs two to four in number, are moderately long ovals, fairly glossy, and of a pale cream almost white ground colour. The markings are not numerous, but are scattered over the whole surface being more dense at the large end. They consist of reddish-brown specks and blotches, with secondary markings of neutral tint.

The average of four eggs is 23·4 mm. by 17·3 mm.

38. **Galerida cristata magna.** Hume's Crested Lark.

One of the commonest birds met with in the fields and waste lands around Quetta, though it also frequents the more open hillsides.

This Lark has a fine song and is a perfect mimic, imitating calls of various birds. It sings as it soars out of sight, and continues its song till near the ground. When on the ground its song finishes in a few disjointed notes.

It commences to nest towards the end of March, and continues to do so as long as there are any standing crops.

39. **Calandrella acutirostris acutirostris.** Hume's Short-toed Lark.

A resident species inhabiting the foot hills of the Quetta Valley, and more abundant among the low foot hills around Pishin and Khanai, where specimens of the parent bird along with the nest and eggs were taken in June.

The nest is of the usual Lark type, placed among stones and small bushes, built of grass and fibrous stems, and lined with fine grass and hair.

The eggs, four in number, differ from those of the Crested Lark only in size.

40. **Picus squamatus flavirostris.** Hargitt's Scaly-bellied Green Woodpecker.

This Woodpecker occasionally comes into Quetta, and there are two Quetta specimens in the McMahon Museum. It is fairly common in the higher Juniper covered slopes of the Miangandi and Marachak Reserves.

We have found its nests in Willow and Pistacia trees.

Though there is ample evidence that it breeds, we have been unable to obtain its eggs.

I have been informed by the Forest Ranger at Miangandi, that these birds are to be seen with young towards the end of July. The nest-holes are very common, three being found in an area of two hundred yards square.

We have not worked this area in June and July, on account of the absence of water and the tiring heat of the place.

This Woodpecker has a loud ringing call, and is common at Ziarat.

41. **Merops persicus persicus.** The Blue-cheeked Bee-eater.

This Bee-eater passes through Quetta early in Spring, and breeds in the territory situated due north. The nearest to Quetta where we have found its nest has been Yaru in the Pishin Valley, on the 6th of July. There was a small colony breeding in a dried-up river bed and all the nests contained young.

42. **Merops apiaster.** The European Bee-eater.

I observed these birds for the first time on the 16th of April, and later found them breeding in the same localities where first seen.

43. **Alcedo atthis pallasii.** The Central Asian Kingfisher.

This little Kingfisher is the only representative of its order in the Quetta Valley, and is to be found all along the River Lora and in gardens where there is enough liquid inducement for it to take up its quarters. There is no difference in its habits from those of the Common Indian Kingfisher.

In the month of June it burrows its nests in the river banks the site of the nest being well advertised by the bird's droppings outside.

44. **Upupa epops epops.** The European Hoopoe.

Fairly common in the Quetta Valley where it breeds, it is a much bolder bird than *Upupa e. orientalis*, and I have seen it drive away a Raven from its nest, which contained young.

Three nests of this species were found, one had eggs on the point of hatching, and the other had full-fledged young, and the third with two eggs, which were left for a full clutch. On visiting the nest five days after, it was found deserted, so the two eggs were taken.

All the nests were in old buildings, where the pointing had given away under the roofs. They were built of various kinds of rubbish, and were very malodorous.

45. **Cuculus canorous telephonus.** The Asiatic Cuckoo.

This is the only member of its order which occurs in the Quetta Valley, and it is not very common, though its call is often heard in the hills to the north. I have only obtained three eggs of this Cuckoo, all of which were deposited in the nests of *Scotocerca inquieta striata*, whilst in a third nest of this species, a broken egg of the Cuckoo was found. In a Finch's (*R. obsoleta*) nest, a couple of nestlings were found, of which one was undoubtedly a young Cuckoo, and a short time afterwards when showing the nest to a friend there was only one young bird in it. A week later I went to procure the young Cuckoo for a specimen and found it dead in the nest. Either the Finches discovered the fraud and in dire revenge administered fatal punishment, or what is more likely, the food of a hard billed bird did not agree with its interior economy.

Two eggs now in my possession are broad ovals, glossy, and creamy in colour, marked with blackish-brown and inky-grey.

They average 22·5 mm. by 17·7 mm.

46. **Asio otus otus.** The Long-eared Owl.

Towards the end of March, I came across a family of five of these quaint Owls in Galbraith Spinney, about three miles from Quetta. They were quite tame and flew about in the day time. The place where I found them was in a plantation of young Poplars, *Populus alba*, an extension of the Spinney.

There are several old Magpie's nests in this area and one of them looked decidedly as if it had been used by the Owls for nesting purposes.

That they breed in Baluchistan there is not the slightest doubt, but the confirmation of this statement must pend the finding of an authentic nest and eggs.

47. **Otus brucei.** The Striated Scops Owl.

Fairly common in certain localities round Quetta. On the 16th of April 1925, I flushed a bird out of a hole in a ' Sticky Plum ' tree in the Miangandi Reserve Forest. On enlarging the hole I found one egg, the bird meanwhile sat close by and when shot, an egg was extracted from the oviduct. The bird has been identified, and is now in the McMahon Museum.

The egg was laid on a few rotting chips and no proper nest was made. The egg taken from the nest was slightly glossy, but the one out of the oviduct was chalky. They are broad ovals, almost spherical, and measure 32·4 mm. by 27·8 mm.

48. **Carine brama tarayensis.** The Baluchistan Spotted Owlet.

This is the commonest Owl in the Quetta Valley, and its habits in no way differ from the rest of its family.

49. **Ægypius monachus.** The Cinereous Vulture.

This large Vulture is to be met with in the high and rugged portion of the district, often coming within the Cantonment limits to feed around the refuse heaps and on carrion. On the ground its movements are very sluggish and it rises with great difficulty, as is common with all members of this family, but once on the wing it is very graceful.

Once while watching a Markhor trail in the hills I observed this beating along the cliff face ; there was never a movement of its stiff outspread wings and the air sang through the end primaries with the same tone as through the stays of an aeroplane.

Three nests of this species were found this season (1925), all on Juniper trees growing in a deep gorge of the Takatu Range. Of these one nest was comparatively easy to get at but the others most difficult.

The second nest was located after we had climbed the summit of Takatu, 11,375 feet, and were working along the ridge which separates Marachak Reserve from Burra-Marachak, which is a very steep valley with almost perpendicular sides of crumbling limestone and volcanic rock.

The nest was about 2,000 feet from the bottom, and the climb down was the worst I have ever attempted. My companion and I, with a Brahuie shepherd, climbed down the cliff—more of a slide than a climb—but however I reached the nest I do not know and I am unable altogether to describe the last little bit. The nest was in front of me and that was all I worried about, and at last we managed to get down to it.

On climbing the tree, which was on the brink of a deep rocky gully, and reaching the nest, I found I could just touch the egg as I stood with my feet at the base of the nest, and eventually I had to scramble on to the nest itself to secure the egg.

The nest was a huge structure of sticks, built and added to for many years, and mixed with rags and skin; it was filthy and had a most offensive smell. In size it measured more than six feet from the base to the top, and about five feet in diameter. The nest proper was a platform and the egg was laid on some grass.

On securing the egg I climbed down and we at once started up the slope again. I followed in the rear, being no climber, and for my temerity nearly got killed by a boulder dislodged by my companion.

Twice on the way up I sat down and nearly cried with vexation. At last we reached the top, and rolled over gasping for water, which was unattainable, and we were faced with the prospect of three miles rough going to the nearest spring.

The two eggs we obtained are broad ovals, pitted and slightly glossy, the ground colour is white, marked with buff and brown.

The egg from the first nest is very beautiful, being nearly all a rich buff, marked with brown, and here and there the white ground showing through.

The egg from the second nest is nearly pure white, being sparingly marked at one end with dark brown and blood stains.

The eggs average 82·2 mm. by 69·4 mm. (C.E.W.)

50. **Neophron percnopterus percnopterus.** The Egyptian Vulture.

This Vulture is very common and resident throughout the Quetta Valley, and in the hills of Baluchistan. Its habits are similar to its congener *Neophron ginginianus*. It builds its nests on the ledges of cliffs and many of them are quite inaccessible. The nests are in some cases large, but more often than not there are only a few rags and stick strewn on the ledge, and the eggs one or two in number, are laid in the centre of this.

The eggs of which I have only obtained two, are fairly moderate ovals, slightly pointed at one end. The texture of the shell is rough, chalky and pitted all over, and marked with reddish-brown and blood stains, on a white ground, one being exceptionally marked. This egg measures 66·1 mm. by 49·0 mm.

51. **Gypætus barbatus grandis.** The Eastern Bearded Vulture or Lammergeyer.

This large Vulture is rather a common feature of the Cantonments above which it is constantly to be seen sailing round in wide circles gradually descending to the ground, where it alights without running as other Vultures do ; also, when it rises, it does so with no more effort than a Pariah Kite.

While on the ground its walk is slow and dignified, the eagle like gait of this magnificent bird on terra firma is very pronounced.

At the same time this does not do away with the fact that it is just as complete a scavenger as any other vulture. Its flight is strong and quick, but I have not yet heard from the local inhabitants of it ever attacking live animals, however much its strength and ease of flight along the cliff faces might suggest such a possibility.

I have found several nests but only obtained two eggs. Another nest which could be got at contained a young bird ready to fly.

All the nests were built in clefts in the cliffs, and were built of sticks, twigs, rag and wool and skin, and anything else the bird could get. They were structures of some depth, but the nest proper was a mere platform with hardly any depression.

One egg now in my possession is a long oval, slightly glossy, and pitted. The ground colour is a dirty white, and the whole egg is covered with brick-red blotches. It measures 81·7 mm. by 66·1 mm.

52. **Aquila chrysætus daphanae.** The Himalayan Golden Eagle.

This fine Eagle is fairly common in the hills around Quetta but I have never seen it in Cantonments. Its flight is strong and its stoop a wonderful sight. Its call is like a yelping dog and it was this call that attracted my attention and led to the finding of my first nest, while I was out Chukar shooting.

The nest was placed in a Juniper tree growing out of a cliff about three hundred feet high, and about half way up. I got ill at this time and could not get out, but I had the nest watched, and a week after I left hospital, we climbed up to it after a great deal of trouble, and with the help of my shikari and collector and a Brahuie shepherd, I managed to get to the nest and recover from it a clutch of two eggs which were well marked.

The second nest was in a similar position and contained one addled egg and a fledgling. The third nest had two eggs which unfortunately got broken in the old shepherd's efforts to dodge the attacks of the birds. He rolled down the hillside about twenty yards, and landed against another Juniper tree, with a cut leg and torn clothes and the eggs in an omelette! This was the only occasion on which the birds attacked us. Several other nests were located but could not be got at.

The breeding season is about the commencement of Spring, though this is dependent to some extent upon the severity or otherwise of the Winter.

The nests were in every case placed in Juniper trees growing on the steep slopes of cliff faces, were huge structures of sticks and twigs mixed with rags and skin, the eggs being placed on a nest-lining of grass. The eggs are broad ovals pointed at one end, slightly glossy, and close in texture, the ground colour is a dirty grey marked with brown and deep purple, with secondary markings of lilac.

They average 78·7 mm. by 41·5 mm.

The natives around here always destroy every nest and egg they can get as the Eagles have the reputation of killing many kids, lambs and sick sheep.

53. **Milvus migrans govinda.** The Common Pariah Kite.

A bird of the Cantonments as it is elsewhere, and in no way differing in its habits from its cousin of the plains.

54. **Milvus migrans lineatus.** The Black-eared Kite.

This Kite is easily distinguished from *M. m. govinda.* by the conspicuous white patch on the under side of the wing, this bird is rarely seen in Cantonments, keeping to the hills and their vicinity.

It breeds in the Spring and during the months of April, May and June. The usual site is on a ledge in a cliff, or on a Juniper tree growing from a cliff or steep hillside.

The nests are well built structures of sticks and twigs, with very little of the rubbish that is usually found in the composition of a Common Kite's nest.

55. **Astur badius cenchroides.** Severtzov's Shikra.

This Hawk is fairly common throughout the Quetta Valley and breeds all through the Summer, building its nests in lofty leafy trees or else commandeering a Magpie's disused tenement.

At Pishin there is quite a colony of them nesting in Beech trees in the Political Agent's compound. This was towards the end of June, and nearly every nest had young. From one nest I got a full fledged bird and an addled egg.

In shape the egg is nearly spheroid and slightly points at one end. The egg is very discoloured, with a bluish lining and with a few faint markings of a pale brown colour.

It measures 40·03 mm. by 33·04 mm.

56. **Accipiter nisus melanoschistus.** The Indian Sparrow Hawk.

A rather rare visitor to the Quetta Valley, arriving about the middle of May, when a few pairs remain to breed.

It is a far more silent bird and more methodical in its mode of obtaining its daily food, and its attacks are conducted without the theatrical show of *A. b. cenchroides*. A nest found at Hannah on the 15th of June contained a clutch of four incubated eggs.

The nest was built in an Apricot tree at a height of about 15 feet and was a well built structure of sticks and twigs, lined with finer twigs.

The eggs are broad ovals, of a rough texture, and of a white ground colour, marked with bold brick-red blotches which are fairly well spread over the egg.

In size they average 43·2 mm. by 32·5 mm.

57. **Falco tinnunculus interstinctus.** The Indian Kestrel.

Very common and resident breeding throughout the hilly tracts towards the latter part of spring.

Three types of eggs have been obtained :(1) White marked with burnt-sienna ; (2) Buff marked with brown ; (3) Pale brick-red marked with reddish-brown. The two latter types are very handsome.

58. **Columbia livia neglecta.** Hume's Blue Rock Pigeon.

This Pigeon is to be met with in certain localities in the hills during the breeding season, otherwise it is very common throughout the Quetta Valley. It builds its nests on ledges of cliffs and, where found breeding in the Quetta Valley, it is sure to be in ' karez ' holes. Its habits are in no way different from the down country Pigeon, nor can I trace any difference in its eggs and nest.

59. **Streptopelia senegalensis ermanni·** The Persian Little Brown Dove.

This little Dove is resident through out the Quetta Valley and only moves down the passes if the Winters are too severe and the snowfall too heavy.

It starts nesting early in Spring and continues all through the Summer and early Autumn. Its nest is the usual classic structure ' two twigs and a cross stick ', and the eggs laid in it are the prevailing type of its down-country cousin.

60. **Streptopelia decaocto decaocto.** The Indian Ring Dove.

This Dove is a Summer visitor to the Quetta Valley, migrating to the lower valleys of Baluchistan in the Autumn.

I first noticed these birds towards the end of March, and a short time after they started breeding.

The breeding season lasts from Spring all through the Summer. The nests are better built than those usually met with elsewhere. The eggs are in no way different from those from any other part of India.

61. **Pterocles orientalis.** The Large, Imperial or Black-bellied Sand Grouse.

On the 18th of May I saw a large flight of these Grouse settle on the plain near Samangli, in the Quetta Valley. They had evidently come from a long distance, as they were not inclined to fly far when disturbed. This is the only Grouse that is to be found in the Quetta Valley. In certain localities it undoubtedly breeds freely, especially on the Mastung and Pishin Plains, and a large number also breed among the low sand hills to the west of Quetta, but many a tiring trudge ended in a futile search for the eggs.

A single addled egg of this Grouse was sent to me by Mr. F. Good from Chaman. It was found at Old Chaman among the foot hills of the Khawajah Amran.

In shape it is cylindrical, being of a pale stone ground colour, marked with brown and underlying clouds of pale inky-purple.

It measures 49·9 mm. by 31·5 mm.

62. **Pterocles coronatus.** The Coronetted Sand Grouse.

A migrant through the Quetta Valley, and while on migration is to be met with in fairly large flights in the Bolan between Mach and Kirtha, but chiefly being found on the open plain between Saranan and Gulistan. It is more common along the Perso-Baluch border, and along the foothills and sandy tracts towards Chaman, where it is replaced by *P. alachata* round Nushki and Ahmedwal.

It breeds in May and June in the wind-swept sand dune tracts of the above-mentioned places, its eggs being laid in a sheltered depression and no attempt being made to line the nest, if such it can be called.

The eggs, three in number, are broad cylinders, rounded at the ends, of a close texture and glossy, the ground colour is either a pale drab, or stone, marked with sienna of varying intensity and having underlying clouds of pale inky-purple.

The average of six eggs is 43·7 mm. by 30 mm.

63. **Alectoris græca koriakovi.** The Persian Chukar.

Chukar are very common in the open season when they congregate in large coveys for feeding and drinking. In the close season, especially when they are breeding, one does not often see them as they keep to the higher portions of the hills where the ground is rough, broken and dangerous.

In such localities there is an abundance of suitable cover in the form of stunted bushes, clumps of grass and boulders which form natural and sequestered nesting sites.

The nest which may be placed under the protection of any of these, is a hollow scraped under the sheltering object. It is scantily lined with grass and leaves, the majority of which are merely wind blown. The Chukar commences to breed about the end of April and continues until about the end of July, though the time is greatly dependent on the weather. It is a strange fact, but true nevertheless, that when the spring rains fail, the following season is a bad one for the Chukar, very few birds breeding. Correspondingly in a year when there is a good rainfall in the spring the Chukar have two broods.

A large number of nests were found, but only two clutches were taken. Large clutches are laid which number anything from nine to sixteen eggs. In shape they are broad long ovals, pointed, at one end ; the texture is close, glossy and pitted all over.

The ground colour is a dirty cream, marked chiefly with a pale brown. These markings are minute and scattered all over the egg and nowhere very dense.

In size they average 43·2 mm. by 30·9 mm.

64. **Ammoperdix griseogularis griseogularis**. The See-see Partridge.

The See-see affects the base of the hills, although at times it is to be met with at considerable heights up the hills and valleys.

It is a lively bird keeping to the fairly dense cover in the scrub of the foothills, and is to be seen in the mornings taking sand baths in the pathways or running over rocks with wonderful agility. It prefers to use its feet rather than its wings.

They are very confiding birds, for, in the summer when the villagers have left their huts in the valleys and moved up the hills in search of pastures new, the See-see is to be seen running about like village chickens. When disturbed they run a short distance but if further followed they take to wing and their flight is strong and quick.

The nesting season lasts from March to June, at which time the male bird is often to be seen perched on some outstanding rock and calling at all hours of the day. In their wild state, they fight long and fiercely, but for all that they are not so popular as cage pets as the Chukar.

The nest is generally a hollow under some sheltering object such as a bush, rock, or a heap of stones. It is slightly lined and this appears to be the work of the bird, as there is a decided moulding and arrangement of the materials which consist of grass, leaves, sticks, etc.

The eggs are eight to fourteen in number, and are broad ovals, compressed and pointed at one end. Some have no gloss and other are slightly so, but all have minute pittings.

In colour they are uniform white or creamy, and average in size 34·4 mm. by 25·6 mm.

65. **Coturnix coturnix coturnix**. The Common Quail.

The Common Quail has been known to breed at Mach in the Bolan and Seistan, but of its breeding in the Quetta Valley I can find no record, though large numbers pass through in Spring and Autumn.

At Woodcock Spinney on the 4th of May a clutch of seven eggs was found in the grass which was then being cut. They were laid in a slight depression under a bush with an apology for a nest. Further clutches ranging from five to nine eggs have since been found. On the 29th of August a clutch of eight partially incubated eggs were found in a ' lucerne field.' This I think is proof enough that a certain number of birds remain to breed both in the Quetta Valley and Mastung whence I have received eggs. The eggs average 28·7 mm. by 23·24 mm.

These quail are difficult to flush but readily come to decoy birds from the surrounding fields when they can be netted in large numbers. After the netting is over the fields in the immediate vicinity of where the nets have been are dragged with a rope and a few brace can be added to the total bag with a gun. The training and care of decoy birds is quite an art in itself and they are treated with more care than a pack of hounds.

66. **Podiceps ruficollis albipennis.** The Indian Little Grebe.

These birds are resident wherever found in the Quetta Valley, but I have only taken its eggs at Khushdil Khan Lake, where it is very plentiful, frequenting the large stretches of weeds, which in Winter, accommodate large flights of duck, affording fine sport.

The nests are close together and are floating masses of weeds, rising slightly out of the water. The egg cavity is a shallow depression generally half full of water, which is the same temperature of the egg. The temperature of the water in the lake itself is much lower, so whether this warmth is derived by the chemical action of the partially decayed weeds or not is not known.

What struck me most about the nests was the fact that though all contained eggs, only a small percentage of them, had their eggs covered, a remarkable thing with Grebes. Some of the fully incubated eggs were as white as when freshly laid. I mention this for purposes of comparison with eggs obtained down country, e.g. in Poona and Bangalore, where in every instance, eggs even if only partially incubated, were soiled or discoloured by their contact with the weeds.

Khushdil Khan Lake, so sequestered and isolate, is an ideal breeding ground for the Little Grebe, and is free from marauding intruders of the Corvidæ family, which may account for most of the nests being left uncovered.

EARLY STAGES IN THE DEVELOPMENT OF GOLD FISH (*CARASSIUS AURATUS*)

BY

M. Hamid Khan, m.sc, ll.b

Superintendent of Fisheries, Punjab

(*With two plates*)

The Gold Fish originated with the Chinese in remote antiquity and was introduced into Europe between the seventeenth and eighteenth centuries, and into America in the nineteenth century. It has been produced from the Crucian Carp, an Asiatic fish of the family Cyprinidæ, after centuries of careful selection and breeding and is therefore one of the Minnows.

The original colour of the Crucian Carp is olive brown and when the young ones hatch out and for some weeks after, they possess this hue of their primal ancestors. If the Gold Fish are left to themselves as in an open pond, they will degenerate more or less rapidly and gradually revert to the original form and colouration of the Crucian Carp. Moreover a large proportion of fish hatched, never do change from their sombre dress, nor take on the brilliant colour so much desired.

Many of the grotesque forms which make some of the popular type of the Gold Fish are the outcome of the centuries of laborious work by the patient, persevering and ingenious Japanese in taking advantage of some curious freaks of Nature.

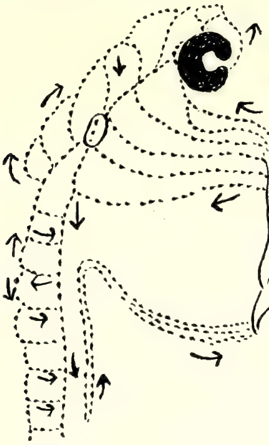
Different varieties of Gold Fish are : Common, Comet, Nymph, Fan Tail, Fringe Tail, Ribbon Tail, Veil Tail, Square Tail, Tripod, Telescope, Celestial, Lion Head, Blue and Black Telescope.

Gold Fish begin spawning usually early in the spring. The approach of spawning time is indicated by males chasing the females about the tank, fighting and splashing the water. The eggs are laid at such times and are fertilized by the milt from the male. The favourite hours for spawning are those which just precede dawn. With the advancing season however daylight spawning becomes more frequent. Chasing and spawning have been observed in our tanks at Madhopur from 7 a.m. to 10 a.m. Only a few eggs are deposited at one time and it sometimes requires several weeks for the female to discharge them all.

The Gold Fish at our Farms spawned at frequent intervals from April to August. The eggs are very small, very light and very adhesive and are yellowish white in colour. They will not hatch if they get very many inches below the water. With grass and weeds planted thickly in the breeding tank the eggs fasten themselves firmly to the leaves, roots and stems. The egg bearing plants are placed in a separate tank with water of precisely the same temperature, as otherwise the adult fish will soon begin to eat them. The eggs hatch out in from 46 to 60 hours.

A comparative study of the life history of the Gold Fish was made. Indian Carp breed once a year during the rains, and it has not so far been possible to find a parallel to the continuous spawning of the Gold Fish, in any other members of the Indian Carp. But life histories of many fishes are still unknown and it is very likely that further researches will throw more light on the subject.

The fish spawned on May 27, 28, 29 and 31, 1926, at 7 a. m. and the eggs were collected on each day and kept separately under observation and preserved in Formalin and Champy's solution for further examination. Eggs are transparent yellowish-white in colour, spherical in form and 1·5 mm. in diameter. The egg membrane is thin. The eggs after fertilization show the blastodisc as circular in form and lying on the left side of the attachment of the egg to



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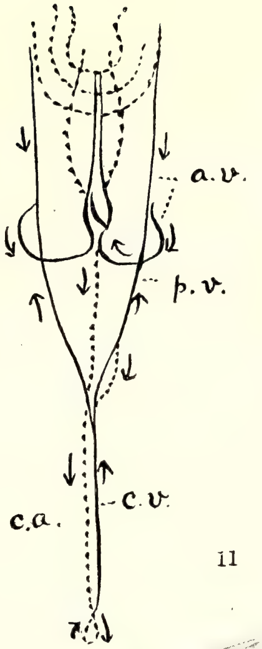

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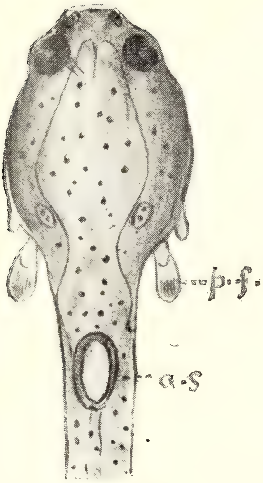

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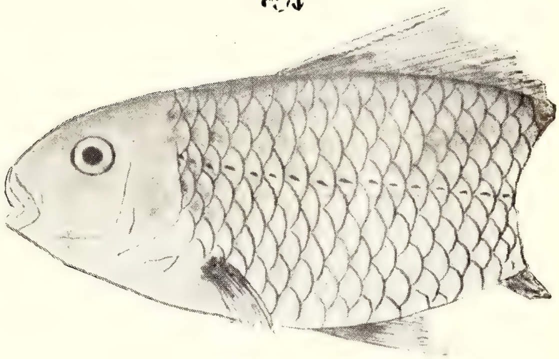

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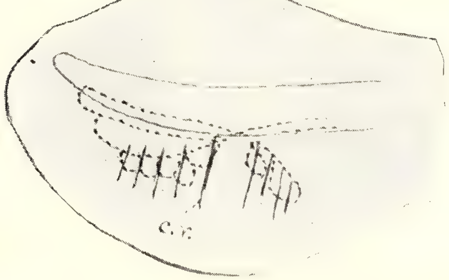

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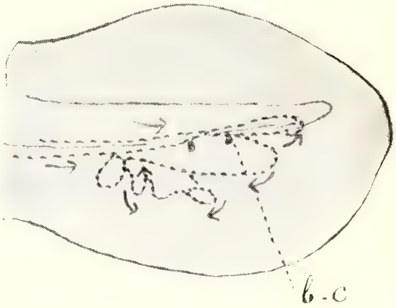

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Fig. 10. First day after hatching showing circulation in the head.
Fig. 11. Circulation in newly hatched embryo.
Fig. 12. Second day after hatching.
Fig. 13. Fourth day after hatching. Circulation in the caudal portion.
Fig. 14. Sixth day after hatching. Formation of the caudal rays.
Fig. 15. Half of the Gold Fish : Caudal portion eaten by fungus.

Abbreviations.—a. s. = Air sac ; *a. v.* = Anterior vena cava ; *b.* = Blastodisc ; *b. c.* = Basal cartilages ; *c.* = Cells ; *c. r.* = Caudal rays ; *c. v.* = Caudal vein ; *e.* = Eye ; *e. a.* = Embryonic axis ; *e. s.* = Embryonic shield ; *g. r.* = Germ ring ; *h.* = Heart ; *p. f.* = Pectoral fin ; *p. v.* = Posterior vena cava ; *s.* = Somites ; *s. c.* = Segmented cells.

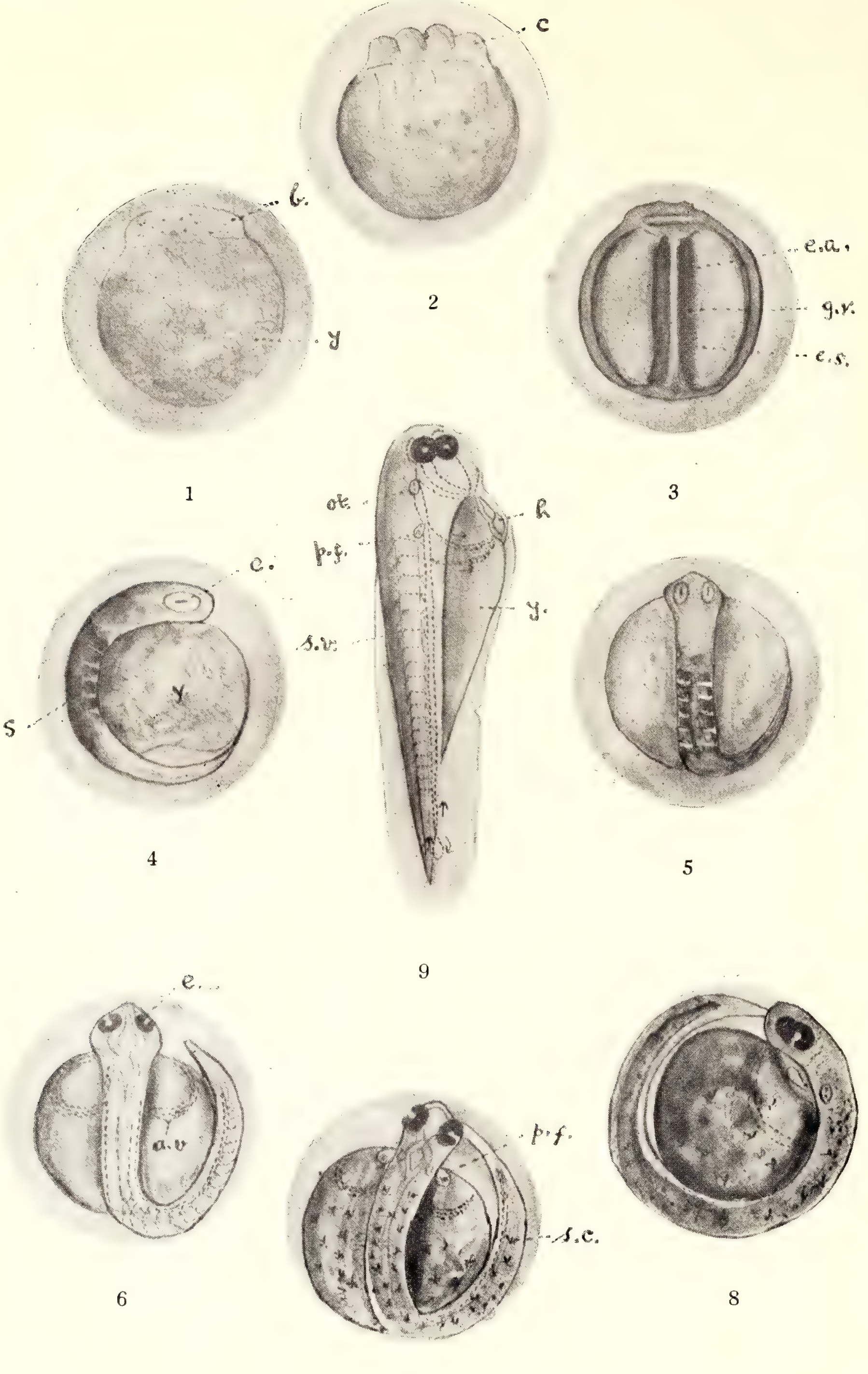
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Fig. 1. Egg just laid.
Fig. 2. Eight cells stage after one hour
Fig. 3. Nine hours' stage.
Fig. 4. Eleven hours' stage.
Fig. 5. Do.
Fig. 6. Twenty-seven hours' stage.
Fig. 7. Forty-six hours' stage.
Fig. 8. Do.
Fig. 9. Newly hatched embryo.

(*For explanation of lettering, see Plate II*) grass or leaf. Segmentation of the egg begins soon after the fertilization; and after one hour the blastodisc is seen divided into cells ; after this stage the division is rapid and two hours' stage shows the protoplasmic disc divided into many cells. The cells have become smaller and at the periphry a thick layer of the protoplasm forming periblast is seen in three hours' stage. In six hours' stage the periblast is seen cut off from the blastoderm, the periphral margin of which is thickened to form the germ ring. The blastoderm extends over the yolk and consequently the germ ring also increases in width. In nine hours' stage the blastoderm seen from the dorsal surface shows a thick triangular area of the germ ring. This is the posterior Embryonic Pole. This area marks the early stage in the differentiation of the embryonic shield. The blastoderm increases in size very rapidly and the germ ring encircles the yolk sphere ; the embryonic shield consequently grows larger and is more definitely outlined. A plug of yolk cells forming the blastopore is seen in nine hours' stage.

A longitudinal thickening from the blastopore to the anterior end is seen in the embryonic shield at ten hours' stage. This is the Embryonic Axis. Eleven hours' stage shows that segmentation of body has already begun, and four somites are counted. Thirteen hours' stage shows eight somites. The embryo is well differentiated with head and tail ends, and with colourless eyes. The blastopore is closed at 14 hours' stage, which shows 13 or 14 somites ; imperceptible outline of 15th and 16th somites is also visible. Eye is still colourless. No movement is yet discernible, the embryo is fixed to the yolk sac at both ends. Sixteen hours' stage has otoiths behind the eyes. The somites vary from 16 to 20. In 20 somites stage the embryo shows slight wriggling movement of the whole mass like shrugging of shoulders ; the head and tail are not separated from the yolk sac, no heart is visible as yet.

In 22 hours' stage heart has appeared but no other vessel is discernible. Embryo is moving wholly within the vitelline membrane. The tail end is detached from the yolk sac. Brain is developed. Soon after, in 25 hours' stage the blood vessels make their appearance ; dorsal aorta, ventral vein, anterior vena cava are the only vessels visible. The eyes are a bit darker. Round pigment cells have appeared. Twenty-seven hours' stage shows the typical embryonic Teleostean circulation ; no gills are seen as yet ; heart gives off branches to the head ; and these unite together to form dorsal aorta, which, posteriorly turns back to form the ventral vein, which anteriorly divides to form two posterior vena cavæ, and these passing through the yolk sac, open into the heart. Rudiments of brain are visible.

In 32 hours' stage the round pigment cells have branched to form stellate pigment cells. Eyes are much darker and can be seen with the naked eyes as two black dots inside the egg membrane. Thirty hours' stage marks the appearance of the segmental vessels. Anterior vena cava passing through the yolk sac has got distinct walls studded with stellate pigment cells. Tail has elongated. Temperature of water 82° F. ; mixed fresh water of 72° F. ; mixed temperature 75° F.

Forty-six hours' stage shows the formation of the Pectoral fins inside the egg membrane. Stellate cells have increased and have rendered the egg opaque. Some eggs of one lot hatched out after 45 hours ; the remainder after 52 to 57 hours. The hatching depends mainly on the temperature of the water : the colder the water the later the hatching. Eggs in 84° F. hatched out in 46 to 54 hours, and in lower temperature in 60 hours.

One egg hatched out under the microscope. Segmental vessels, Pectoral fins are present from the very beginning. The embryo bursts open the egg membrane by its tail which comes out first, the head is still inside the membrane. The embryo shakes its head just like a dog and frees itself of the covering. To the egg membrane are attached innumerable verticellæ. Yolk sac is elongated posteriorly.

Three aortic arches are present. Posterior vena cavæ join behind the yolk sac to form the caudal vein. The path of the anterior vena cavæ is marked by pigmented walls. The posterior circulation is typical ; just at the posterior end of the yolk, posterior vena cava has got reverse circulation in a branched vessel. The posterior circulation does not extend to the extremity.

First day after hatching ; the embryo shows (i) reduction of yolk sac, (ii) round pigment and stellate cells on the dorsal surface of the head and (iii) development of six aortic vessels. Head vessels have multiplied. The heart is becoming complex. Stellate pigment cells have collected near the end of the notochord. Pectoral fins are elongated and movements are very swift. Air sac appears after 20 hours. Twenty-four hours after hatching, mouth opens for respiration ; and opercular membrane appears over the gills, and an air bubble is formed in the sac. Nostrils have appeared. Yellow pigment is laid over the dorsal surface. The yolk sac is reduced, the embryo lies on its ventral surface. Yellow colour predominates. Operculum is well developed ; stellate pigment cells have become rounded and are fewer in number and are confined to the dorsal surface. The caudal vessel has given off a tiny branch to the ventral mass of pigment cells, marking the beginning of caudal capillaries. Third day shows yellow colour to be all over surface. Eyes have purple pigment as well. Yolk sac is much reduced. Caudal capillaries and pigment cells have increased in number. Simple gut is formed, the yolk sac has become converted into gut cavity lined by colomnar cells. Dorsal view shows the formation of cerebral hemispheres with olfactory lobes. Lower jaw is moving rythmically. External gills are seen peeping out of the operculum at its lower end and richly supplied with blood vessels. Otoliths are enlarged and embedded in the sides of the brain at the region of the auditory organs. Gut is simple, tubular structure and opens posteriorly. The yellow colour is more pronounced. The black pigment cells are quite round and smaller in size and fewer in number and are on the dorsal surface only. Caudal circulation is advanced to the extreme posterior end of the notochord. Caudal cappillaries have increased in number. Sixty-five hours' stage after hatching shows the appearance of three small bluish basal cartilages, close to the notochord on the ventral surface, where caudal capillaries are present ; and black pigment cells are mixed with yellow pigment cells. Small round pigment dots appear on the lips.

Fourth day indicates the formation of the liver just below the air sac, red in colour. Basal cartilages have enlarged. External gills have disappeared and the operculum covers the internal gills. Caudal capillaries have increased in number, and two more basal cartilages have appeared.

Fifth day. Four small bluish caudal rays have just appeared on the ventral side amongst the black pigment cells which are arranged radially. The round pigment cells (black) are present on the ventral and dorsal surface of the notochord. Eight hours after, nine rays are discernible.

Sixth Day. Four caudal rays have elongated and reached the basal cartilages, and eight more are visible and two or three are developing. Eight hours later, the caudal rays have elongated, five on each side and the blood vessels are in the middle. Notochord is bending dorsally.

Seventh day shows ventral fin developing as well, while the dorsal is not yet begun. The caudal is more or less fully developed and is separating from the ventral.

Eighth day. Air sac is divided into two chambers. The notochord is bent dorsally and whole of the caudal fin is formed from the caudal rays on the ventral surface of the notochord. Dorsal fin has separated off from the caudal, ventral has got four rays but is yet connected with the caudal, which has 14 to 15 rays and five to six basal cartilages.

Three months old fry have been seen to change their colour. But all the young ones do not take up the parental colour ; many of these remain olive brown.

REMARKABLE VITALITY OF GOLD FISH

One of the Gold Fish, nine months old, born in April 1925, was seen on January 23, 1926, to have a very big white tuft of fungus on its caudal portion. It was removed from the main tank and put into a salt bath. Fungus outgrowth was removed with a pair of forceps and the affected portion smeared with salt. The fish was kept for a fortnight in a salt bath and the wound regularly cleaned. It was fed on wheat flour, and boiled rice. After a fortnight of the treatment the flesh from the affected area began to peel off gradually, ultimately leaving the caudal fin and the vertebral column up to the posterior extremity of the dorsal fin quite bare. After the same treatment had been continued for a week more, the whole of the affected area including the caudal fin and vertebral column fell off; leaving only half of the fish quite healthy. The wound was ugly to look at, but it healed completely in a week.

The fish was found to be a ripe male in March 1926. It was kept separate from the other lot and its measurements were taken on March 3, 1926, as follows: Total length of the body, 2″. Total length of head, 9″. Total height, 1·2″.

Length of the Pectoral Fin, 5″.

Length of the Pelvic Fin, 6″.

Anal Fin was a hard mass of rays united together. Had the fungus extended a little more anteriorly, the vital organs would have been affected and the fish would have died at once. The fish, however, died in September 1926.

BOMBAY MINERALS

BY

JAYME RIBEIRO, L.C.E.

FOREWORD

The main geological formation of this little Island of ours is a bit of the western fringe of those stupendous flows of lava which have raised the vast plateau of the Deccan to its present height, supplemented by a couple or more of local outbursts of molten matter. Other minor volcanic activities of a different type locally or in the immediate neighbourhood were not infrequent. They have given us those distinctive rocks, the breccias, lying along the eastern boundary of Bombay. Between some of these periods of cataclysmic disturbances there occurred long, quiescent intervals which gave time for the formation of lakes and rivers and for the deposition in them of sedimentary strata. Thus within the small compass of our City we get three distinct rock formations : the traps, the breccias and the aqueous beds. Each of these being quite unlike the other in its physical aspect and composition we will not be far wrong in expecting each formation to have its own characteristic mineral deposits.

The geology of Bombay has been well studied by many eminent men and the minerals met with in the rocks noted ; but so far as I am aware no geologist or mineralogist has considered it worth his while to give a detailed description of their natural setting or of the modifications occurring in the minerals themselves. To say briefly that in the traps are found calcite, quartz, zeolites, etc., gives one no idea of the wide range of the crystallisations of calcite, of the pretty manifestations of quartz or of the beauty of the zeolites. Some twenty years ago having noticed the great variety of minerals to be obtained in the Bombay rocks, I set out to collect them, at first in an amateurish way, and the result of the twenty years' labour is embodied in the **'Jayme Ribeiro Collection of Rocks, Minerals and Fossils from the Island of Bombay'** offered to the Prince of Wales Museum of Western India by the writer of these notes. There are some minerals in the collection which, I believe, have not been previously known to exist in the rocks of Bombay. The collection could have contained better and more perfect specimens and perhaps even a larger variety were it not for the apathy of the quarry owners who, though requested, would never keep aside any mineral they came across. It was not their business.

India is a place where one meets with a difficulty at every step. Neither in Bombay nor anywhere else in India could I get facilities for identifying the minerals I had collected. Having had an occasion to speak about it to Dr. J. W. Gregory, F.R.S., Professor of Geology at the Glasgow University, he most sympathetically undertook to do all he could to help me. At his request the determinations of most of the minerals described in these papers have been made by Miss Agnes Neilson, Lecturer in Mineralogy at the same University. I take this opportunity to tender to both of them my sincerest thanks.

Without laying claims to a specialized scientific training on the subject, I consider that an accurate record of the mode of occurrence of the various minerals with their surroundings and associates may lead to a correct idea of the way crystals are formed. A careful consideration of the minerals found in Bombay makes one doubt whether they are all deposited from mineral laden waters. There may have been other agencies at .work. The object of these papers is to record the manner in which the various minerals are occurring in the rocks of Bombay. It is my earnest hope that a trained mineralogist may come forward to make a systematic study of these minerals and that these notes may be of help to him.

QUARTZ

Introductory.

The pride of place as the most widely disseminated mineral in Bombay, as also in most parts of the world, is certainly held by quartz, even if we exclude the sand on the sea-shore and treat exclusively of the quartz found as a chance mineral in the rocks of our City. Its distribution in the different strata varies a good deal. In the upper basaltic trap the occurrence of quartz is very rare but not so in the soft grey scoriaceous lower trap. This rock is teeming with crystalline quartz though even here the unequal distribution is in evidence. There are sections of the quarry where no quartz can be seen while a few feet away it strikes the eye everywhere. In some of the breccias quartz occurs extensively whilst in the others there are only traces of the mineral. When however we come to the sedimentary beds the presence of quartz becomes quite negligible. If one hopes to come across gigantic crystals of about 3 feet in length recorded in the mineralogies as occurring in other parts of the world or even of as many inches, he will be sadly disappointed. He will also be disappointed if he seeks for semi-precious quartz. The mineral occurs in Bombay mostly in very tiny crystals which are however perfect specimens of their type. They invariably consist of a hexagonal prism capped at one or both ends by a pyramid. Chalcedonic quartz does exist but it is relatively rare. Even the quartz deposited in the trap veins resulting from the cooling of the lava discloses more often than not a crystalline nature though it does not show distinct crystals. As the quartz found in each of the geological formations of Bombay has its own distinctive characteristics, I have found it more convenient to treat the quartz of each rock separately.

Quartz in upper trap.

Besides the frequent deposits of crystalline quartz in the veins of the rock, there are occasionally found small cavities which are lined with crystals of quartz. These rock cavities generally occur in tiers and are flat. The quartz in them is of the usual type described under the lower trap and does not call for special notice. In one case, however, the quartz was overlain with a fine crop of small sized stilbites of a pleasant green colour.

Quartz in lower trap. Occurrence.

It is in the lower trap that the most striking and spectacular manifestations of quartz obtain. One finds the mineral embedded as needlelike crystals in the mass of this soft, grey, scoriaceous rock, or lining with well formed minute crystals small drusy cavities, or enclosed in amygdules. It is, however, when we come to the larger cavities that the best effects are seen. Here the crystals are arranged in clusters on all sides or hang down from the roof in festoons and flimsy draperies. Very often the effect is heightened by larger but duller crystals of calcite lying on the brighter quartz crystals. When the sun strikes such a cavity the light scintillates, occasionally with rainbow colours, from myriads of tiny facets. They are veritable fairy caves and defy description. The prettiest effects were obtained in a cavity in the Sewri Hill near Jackeria Bunder Road where in addition to calcite there were groups of colourless, transparent acicular crystals of aragonite which split up sunlight into its component colours with more facility. There is a marked difference in the nature of the larger and the smaller cavities. The former seem to be due to the joints of cooling being subsequently enlarged by the action of percolating waters, while the latter are probably bubble cavities in a chilled mass of rock. Such masses are at times very extensive, perhaps up to and above 50 c. ft. in volume. The whole mass is honey-combed with small, very flat hollows set in tiers. The crystals in them may have evolved by the sudden cooling of the rock. What caused this cooling in the heart of the trap is rather difficult to say. In the eroded hollows the quartz was probably deposited from percolating water. The quartz occurs in such profusion that the crystals are cramped for space. It is a hard struggle for life. They butt against, and penetrate into each other. They peep out from prehnitic masses. Some shoot their heads high above their fellows as if to gain more freedom. They lie on lumps and crystals of calcite, and are even buried in them. They are found delicately poised on slender needles of luamontite.

Quartz in lower trap. Crystallization.

The quartz in the veins of the rock is crystalline without distinct crystals or chalcedonic. In the amygdules it is very frequently of the latter type. In general, however, the quartz occurs in very small crystals in a good state of preservation. It is rarely that weathered crystals are found. They are of the usual hexagonal type with pyramids at one or both ends. In the amygdules of the Sewri Hill near Jackeria Bunder a very pretty modification has taken place. The crystals appear in sheaves, the prisms thickening from the pinched waist towards the pyramids. In a peculiar boulder met with in the lower trap at Worli, some of the crystals have their tops fused and rugged as if altered by intense heat, while others have their pyramids cut off in a plane which gives a pentagonal appearance to the face.

Quartz in lower trap. Coloration.

The crystals are generally colourless and transparent, occasionally slightly creamy. Very often they obtain a pleasant orange tint from decomposing cubes of iron pyrites resting on them. Those found in a cave in the Sewri Hill, Jackeria Bunder, have a pinkish shade. The fused crystals of the Worli boulder are smoky or rather dark brown. Weathered quartz takes on the appearance of kaolin.

Quartz in lower trap. Association.

As stated previously the quartz in this formation is found in pretty association with a variety of minerals. The ubiquitous calcite is the most important of these, not only for its setting but for the variety of its crystallizations. Iron pyrites, which is unexpectedly so frequent in Bombay, penetrates even into the amygdules. Zeolites are frequent with the quartz in the Golangi Hill and Worli Hill traps while aragonite is an addition in the Sewri Hill and in rare cases apophyllite in the Worli Hill rock. The pinkish crystals of quartz of Sewri Hill cave were lying together with the only specimen of bluish barytes found in Bombay, pyrites and calcite being the other associates.

Quartz in Sewri Cemetery Hill trap. Occurrence.

The trap rock forming the Nowroji Hill in Dongri is akin to the rock of the Sewri Cemetery Hill situated to the south and east of the Sewri Cemetery. The formation is however quite distinct in its physical aspect from the upper basaltic or the lower scoriaceous trap but the probability is that both these ridges owe their origin to the same flow of lava that gave rise to the latter trap. The quartz found at Nowroji Hill, in veins as well as in cavities, has no special characteristics. The case completely alters when we come to the quartz obtained in the Sewri Cemetery Hill. Here occurs the unique manifestation of quartz in independent crystals. They are found in the bituminous caves embedded in or encrusted on the surface of prehnitic plates and masses, but most frequently lying loose in the ashy grey debris resulting from the admixture of decomposing apophyllites and laumontite with bitumen. When the largest cave was first blown through the workmen noticed these bright, well facetted crystals and carefully picked them up with an idea that there was money in them. On my learning of the find I went to the place and with much difficulty picked up a few crystals from the debris and loose earth lying about, as no workman would part with a portion of his holding. Subsequently, when the smaller bituminuous caves were met with, careful observation gave me the clue that the crystals would be found in the debris covering the cake of bitumen. This was forthwith collected. Following the system adopted for obtaining placer gold, I was able to obtain a large quantity of crystals. The quantity however pales into insignificance when compared with the extensive deposits of quartz found in the other strata in Bombay, in fact all the crystals gathered from a large cave discovered in the Municipal quarry will weigh only about four ounces. A few solitary crystals were found attached to the rock in the cave where the semi-liquid bitumen was discovered. In the portion of the Hill to the east of the Cemetery where otherwise the rock does not show extensive deposits of quartz, the only specimen of bedded, chalcedonic quartz, white with lighter bands resembling an agate, was met with in December 1921. It formed a layer about 3 sq. feet in area and $1\frac{3}{4}$ inches thick in arock cavity. The surface was covered with a mixture of earth and weathered zeolites. The quartz is partially weathered and shows on the underside an excellent pattern of dendrites.

Quartz in Sewri Cemetery Hill trap. Crystallization.

The crystals vary in size from microscopic dust to about an inch in length. Whether small or large they are well formed, though, as is common with quartz, the columns as well as the pyramids are in general irregular. They have hexagonal prisms with pyramids at both the ends. Very often the column is unusually long giving to the crystals a needle like appearance while in other cases the prism is wanting altogether, the two pyramids being joined at their bases. It is very common to see two or more crystals joined together, or one crystal penetrating into another. Cases with additional rhombic faces at the junction of the prism and pyramid are not infrequent. The interior of the larger crystals is invariably fractured. There are indications of minute air bubbles. Striations on the faces are not so pronounced as is generally the case with quartz. On the plates of prehnite there are small deposits of rough sandlike quartz.

Quartz in Sewri Cemetery Hill trap. Coloration.

The crystals are bright and colourless. In some, however, and especially in the larger ones, the central portion is clouded and opaque. In a few cases the crystals at first sight appear black owing to the proportionately large quantity of enclosed bitumen. There are no instances of any coloration, either natural or accidental.

Quartz in Sewri Cemetery Hill trap. Association.

The quartz crystals in the caves are associated with a variety of interesting minerals. They are certainly coeval with the bitumen and the prehnite. They are lying on the surface of the bitumen and at the same time carry particles of solid black, as also of the lighter semi-liquid, bitumen embodied in the mass of the crystal. While they were resting on the bitumen thin plates of prehnite seem to have been deposited on them as evidenced by some of the crystals being caught in the under surface of the plate. In other cases the crystals are deposited on and partially encrusted in masses of prehnite, in the sides and the roof of the caves. The calcite, apophyllite and laumontite were probably later intruders. The mode of occurrence and of association with the other minerals gives one the conviction that these independent crystals of quartz evolved directly from a gaseous state of silica. In the Nowroji Hill Trap the bitumen is absent but the other minerals with the addition of chabasite and fibrous stilbite are found together with the quartz.

Quartz in breccia. Occurrence.

It is however when we come to the volcanic breccias of Bombay that we find the mode of occurrence and the character of the quartz a good deal different from the trap quartz. The distribution is again unequal. Only minute crystals calling for no special notice are scantily found in the thin veins in the Bhandarwada and Rowli Hill breccias which are soft and earthy, in striking contrast to the hard, compact Golangi Hill rock which is liberally interspersed with deposits of this mineral. The quartz occurs in well formed geodic cavities or nodules. They are invariably crescent shaped in section with the concave side downwards ; in fact a carefully detached geode gives the impression of a hot water dish. The geodes vary from very small amygdules to as much as a foot or perhaps more, in diameter. The smaller nodules are sometimes so profuse in the rock that the breccia has the appearance of a pudding stone.

Quartz in breccia. Blistering.

In some instances the surface of individual crystals is blistered by small boils. The face of the crystal under the blister is eaten into to some extent. The material destroyed is apparently more than what would be required to form the film of the blister. As the surface under the film is smooth and shining and not roughly corroded, it seems that these blisters were bubbles resting on the face of the primitive crystal which subsequently increased in size by the deposition of fresh silica all round but not under the bubble. This view is remarkably corroborated by specimens where the bubble is large enough to cover several crystals. The crystals within the bubble are certainly smaller than those outside it ; nay, where the edge of the bubble film rests on a part of a crystal, the portion of the crystal outside the film has grown while that inside remains small. Whether large or small the bubbles have a rough rhombic shape. Some of the films themselves have become thicker by the subsequent deposition of fresh silica.

Quartz in breccia. Crystallization.

The crystals in the geodes are well formed and very often fairly large. They are invariably of the hexagonal system. It is only the pyramids of the crystals that in general protrude beyond the compact mass formed by the prisms. Pyramids at both the ends of the prisms are occasionally found in smaller cavities within the geode. Specimens are met with in which the crystals have the appearance of frosted glass with a peculiar satin sheen. Under the microscope this is found to be due to the deposition of very minute crystals of quartz. Their form appears to be similar to that of the main crystal, though even under a powerful magnification the form cannot be definitely determined. Striæ are distinct on the faces of the columns as also on the fractures of the pyramids roughly following the contour of the faces. It is rarely that the base consists of chalcedonic quartz. In one case the crystals were starting from what seemed to be a block flinty layer. Some of the crystals, due to weathering, are showing on the surface a kaolin-like opacity though the interior is still crystalline and brilliant. It is not infrequent to find the geodic cavity filled with lumps of badly formed, to all appearances, weathered crystals. Under the magnifier some of these lumps, however, resolve into very pretty clusters of well developed crystals. A very remarkable occurrence is the presence within the geodic cavity of very delicate and brittle films of quartz showing minute crystals on the surface. The structure is sometimes so flimsy that the crystals seem to form a net work. The only object with which I can compare these films is the envelope of a dried soap bubble. In fact they give the impression of being bubbles. The compact nodules consist of crystalline or chalcedonic quartz.

Quartz in breccia. Coloration.

It is again the breccia that yields specimens of coloured quartz in Bombay. Though in general the crystals are colourless transparent or milky white, there are frequent instances where the crystals show a slightly smoky or a lightly amethystine colour. It is only the apexes of the crystals that are tinted, and that also in patches. When however we come to the combination of the two colours, we get a deeper shade of what may be aptly called 'Smoky-amethystine'. It is peculiar that in most cases of the real amethyst quartz the tips of the roof and bottom crystals, which are otherwise well formed, meet together and interlock giving a violet coloured band in the centre of a colourless nodule. Besides the inherent colours, there are adventitious shades of yellows, browns, and reds due to the oxide of iron. The source of the coloration is still visible in most specimens as a weathered crystal of iron pyrites diffusing colour all round it. The colour is very often absorbed, due to this peculiar property of quartz, into the body of the mineral and cannot be washed off, differing thereby from the coloration due to earthy deposits. The iron oxide is also found forming a film on the surface of the crystals which thereby acquire a greater brilliancy and frequently give out iridescent colours when held in the sunlight.

Quartz in breccia. Association.

Unlike the trap quartz which is invaribly associated with other minerals, the breccia quartz is practically unmixed, except for sprinklings of perfect cubes of iron pyrites which not only lie on the surface of the quartz but are even found embedded in the mass of the quartz crystal. The way the pyrites is deposited in the latter case throws an interesting side-light on the formation of the crystal. It is clear that the pyrites got, in the first instance, deposited on the surface of the crystal which subsequently grew by fresh deposits of silica. In a specimen picked up from the so-called Lydian Stone (generally considered to be a breccia) of Antop Hill, there are minute specks of some sort of impurity other than pyrites inside the crystal. Calcite, which otherwise intrudes itself practically into every rock cavity in Bombay, is quite rare in the geodes. In the few instances where it does occur, its presence seems to be resented by the silica, and it is thrown out as an impurity on the quartz' crystallizing. It is further encased within thin plates of quartz. Inside the casing the calcite is seen as a dirty brown substance in its common rhombic form. It would appear that once the rock cavity is completely lined with a deposit of quartz no further infiltration of mineral laden waters is possible, though there is a chance of this taking place through the thin veins that are usually found on the exterior surface of the geode. The geodic hollow very often contains a deposit of loose, coloured earth akin to the breccia. Either this material was already in the hollow in a loose condition when the infiltration of silica took place, or it may have been carried down in solution along with the silicious water to be subsequently thrown out as an impurity on the crystallization of the quartz.

Quartz reef in breccia.

About a 100 feet east of Sion Road at mile stone VIII an extensive deposit of mass quartz was met with in December 1921. The reef was about 40 feet long and 2 feet wide. Unfortunately its depth could not be ascertained as the quarrying operations were stopped at road level. Its general appearance is that of quartzite being crystalline without showing distinct crystals except in the small cavities in the mass itself wherein there occur well developed minute crystals variously coloured by iron oxide. Lumps of bright sulphuret of iron are not wanting. Bits of the breccia itself are caught up in the mass of the quartz which probably owes its slight tinge of colour to the same source. It would be worth inquiring into the causes which brought together such a large mass of quartz in a rock which otherwise shows no traces of the mineral.

Quartz in sedimentary beds.

When we come to the sedimentary strata we are greatly disappointed by the very poor manifestation of quartz in these layers which are otherwise interesting in furnishing a rich variety of calcite crystals. It is only rarely that one comes across very minute, colourless, hexagonal crystals of quartz deposited in the vertical cracks in the aqueous beds in Worli Hill, while so far, I have not come across any traces of quartz in the Sewri Hill and Bhoiwada beds. This remarkable absence of a mineral which is so profuse in the other strata in Bombay is rather inexplicable.

CONSPICUOUS FLOWERING TREES OF INDIA

BY

W. S. MILLARD AND E. BLATTER

PART I.—(*With two coloured and two black and white plates, and four text figures*)

INTRODUCTION

This series will deal with some of the most beautiful flowering trees of India and it has been prompted by the many enquiries which are constantly being made as to the correct names of such conspicuous trees when in flower.

It is not always an easy matter to find out such names unless one is botanically inclined, and many people have not the time for such research or the opportunity to visit Botanical and Horticultural Gardens, where specimens of these trees might be found with the correct names.

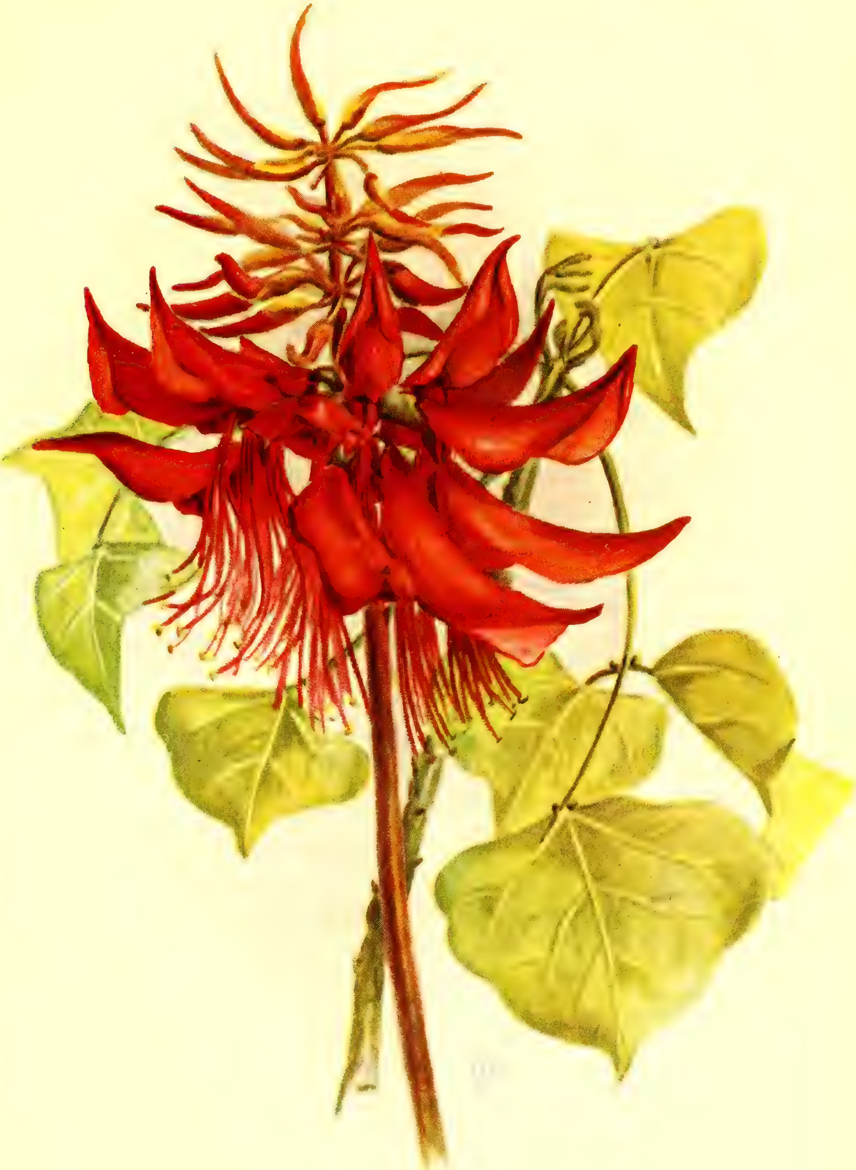
We are, therefore, giving in these articles short descriptions in popular language, with coloured and black and white illustrations. It is hoped that the series will prove of assistance to those who take an interest in these beautiful trees and wish to know not only their correct names but also something about their history.

The coloured plates have been reproduced from drawings from life by the following artists to all of whom our thanks are due: Miss M. Thacker, Miss Gwendolen Millard, Mrs. Kinnear, Sister Mary Chionia of All Saints' and Mr. S. H. Prater.

ERYTHRINA, Linn.

(The name is derived from the Greek *erythros* red, alluding to the colour of the flowers which are mostly red.)

Erythrina is a genus of papilionaceous trees and shrubs, popularly known as Coral-trees, but is also represented by herbs. About 50 species have been found in tropical and warm temperate regions. Some attain great dimensions, while others are dwarf bushes with a woody rootstock or even herbs. In many the stems, branches and leaf-stalks are beset with prickles. The leaves consist of 3 leaflets, with the lateral leaflets opposite to each other. The flowers are large, mostly red, and arranged along a common stalk (raceme). The calyx is two-lipped or oblique (spathe-like). The standard is sessile or shortly stalked (clawed), upright or spreading, much larger than wings and keel. The stamens are united to the middle, the upper one free or united at the base with the rest. The anthers are equal and the style bent inwards. The fruit is a slender, stalked pod, constricted between the seeds, narrowed at both ends, opening more or less completely into 2 halves; the seeds are mostly egg-shaped.



INDIAN CORAL TREE.
Erythrina indica, Lam.

In India 8 indigenous species have been observed; two more have been introduced.

Key to the indigenous species :
A. Trees
I. Calyx spathe-like, oblique, splitting, not at all 2-lipped.
1. Calyx splitting to the base
(*a*) Tip of calyx 5-toothed ... ... 1. *E. indica.*
(*b*) Tip of calyx not toothed ... ... 2. *E. stricta.*
2. Calyx splitting half-way down ... ... 3. *E. mysorensis.*
II. Calyx bell-shaped, more or less distinctly 2-lipped, but not splitting down to the base.
1. Pod swollen, bearing seeds throughout the whole length
(*a*) Leaflets much longer than broad ... 4. *E. fusca.*
(*b*) Leaflets as broad as long
* End-leaflet rhomboid or egg-shaped. 5. *E. suberosa.*
** End-leaflet nearly kidney-shaped ... 6. *E. arborescens.*
2. Pod flat, seedless in the lower half ... 7. *E. subumbrans.*
B. Undershrubs or herbs ... 8. *E. resupinata.*

1. **Erythrina indica,** Lam. Encycl. Meth. ii (1786), 391; Roxb. Fl. Ind. iii, 249; Wight Ic. t. 58; Baker in Hook. f. Fl. Brit. Ind. ii, 188; Brandis For. Fl. N.-W. & Central India (1874), 139; Talbot For. Fl. Bomb. i (1909) 400, fig. 225; Brandis Ind. Trees (1911), 226; Cooke Fl. Bomb, i, 366; Gamble Fl. Madras, 353; Troup Silvic. Ind. Trees (1921), 265; Haines Bot. Behar and Orissa (1922), 284.

Erythrina corallodendron, Linn. Sp. Pl. 992 (*partim*).

Erythrina corallodendron, Lam. Encycl. ii, 390.

Erythrina carnea, Blanco Fl. Filip. ed. i, 564.

Erythrina orientalis, Murr. in Comm. Götting. viii (1787), 35, t. 1. Rheede Hort. Malab. vi, t. 7.

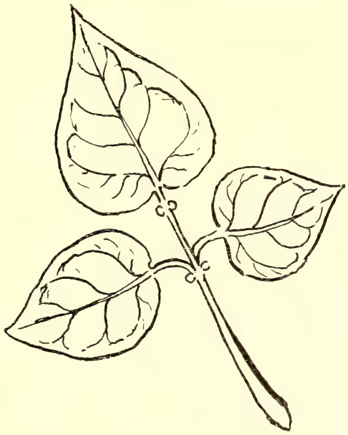


FIG. 1.

Popular Names :—The Indian Coral-tree, Mochi-wood; Pangra, Pangara, Mandara (Hind., Mar.); Panaroo, Panarweo (Guz.); Halivara, Mullumutala (Kan.); Modugu (Tel.); Palte-madar, Palitamundar, (Beng.); Marar, Pharar, Hadbad (Bihar and Orissa); Kathit, Pinlekathit (Burm.); Mandara (Sanskr.).

Description : A moderate sized tree, reaching 60 ft. in height, with a straight trunk and numerous branches. The branchlets are armed with small, dark-coloured, conical prickles up to third or fourth year. The bark is thin, yellowish or greenish grey, smooth, shining, with longitudinal whitish cracks. It exfoliates or peels off in papery flakes.

The accompanying diagram illustrates the leaf, which is composed of three leaflets, the terminal one being the largest. The leaf stalks and leaves are without prickles. The leaflets are covered with star-shaped hairs when young but are hairless when mature. The flowers, which are large and numerous, of a bright dazzling scarlet, growing in a single or in several racemes, at the ends of the branchlets, appear before the leaves and are arranged in clusters, one to three blooms emerging from a common stalk.

The diagram illustrates the composition of the flower and the appearance of the bud. The segments which form the calyx of the bud are fused to form a tube which is narrowed at the apex and ends in 5 points, 2 of which are distinct and extend beyond the tip.

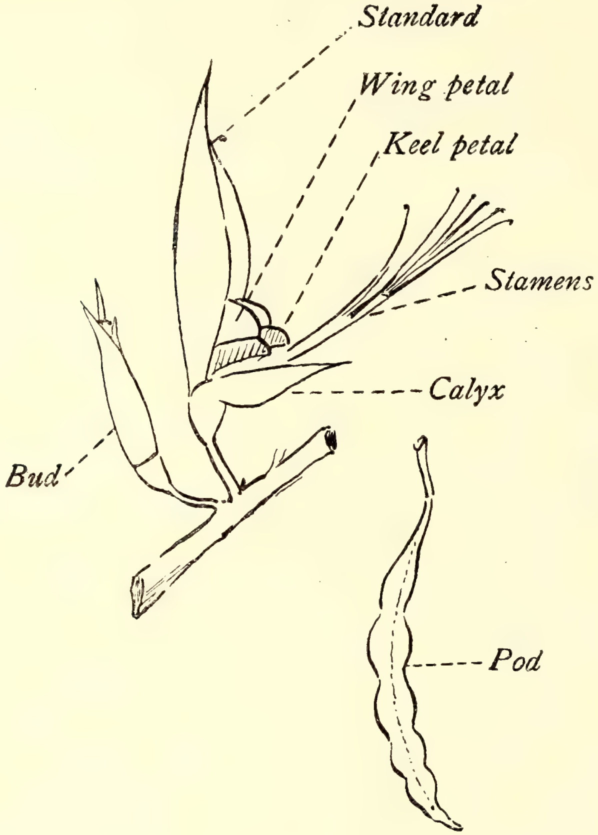


FIG. 2.

When the bud opens the calyx splits down the back to the base and forms an open sheath. The corolla, it will be seen, is composed of 5 petals :—an errect, oblong, standard which narrows at the base into a claw, two small wing petals and two, almost similar-sized, keel-petals of a distinctly darker hue. The wing petals partially enclose the keel.

The stamens protrude for almost their entire length. They are united into a bundle at the base; higher up, the tenth stamen is distinct and free.

The pods, which are many, grow on a stout stalk and attain a length of 5-12 in. They are somewhat curved, constricted between the seeds, beaked at the tip, and narrow down to a seedless base. When dry they are black and wrinkled. The pod contains from one to 12 seeds.

The seed is oblong, smooth, its colour varies from red or dark red to purple or dark purple or brown.

In a former number of this Journal (vol. xxxiii, p. 460) Mr. T. C. N. Singh has described how the Mynahs (*Acridotheres tristis tristis*) promote pollination of the flowers of the Coral-tree in Lucknow. The Editors have pointed out that in Western India a great variety of birds are regular visitors of the Coral-tree when in flower contributing thus to its pollination. Among the birds to be invariably met, in addition to the Mynah and the Crow, are mentioned the Rosy Starling (*Pastor roseus*), Babblers (*Turdoides*, *Pyctorhis*, and *Dnmetia*), Drongo (*Dicrurus*), Wren Warblers (*Prinia socialis* and *inoruata*), Tailor Bird (*Orthotomus sutorius*), Bulbuls (*Otocompsa*, *Molpastes*, *Pycnonotus* and *Chloropsis*), Grey and Black-headed Mynahs, Black-capped Blackbird (*Merula nigropileus*) and the Tree Pie (*Dendrocitta*).

Flowers from February to May before the young leaves issue.

Fruit ripens from May to July.

The old leaves are shed early in autumn.

Distribution : Reported to be indigenous inland in deciduous forests of Thana, the Konkan, N. Kanara and Malabar, and from the Sunderbunds along the coast through Arakan, Pegu, Tenasserim, the Andamans and Nicobars, Java, Polynesia. On the west coast it is found above high-water and, according to Talbot, sometimes associated with *Calophyllum inophyllum*, *Salvadora persica*, *Clerodendron inerme*, *Grewia microcos*, *Canavalia ensiformis*, *Derris uliginosa*. In the Andamans it grows together with *Mimusops littoralis*, *Calophyllum inophyllum*, *Thespesia populnea*, *Terminalia Catappa*, *Heritiera littoralis*, *Afzelia bijuga*, *Pongamia glabra* and *Hibiscus tiliaceus* (Troup). Haines thinks it may be wild in Khurda where the tree is very common.

Otherwise this species is cultivated and self-sown all over India, in hedge-rows in Bengal.

Uses : In the Peninsula, and especially throughout the Presidency of Bombay, it is largely grown to support the betel and pepper-vine. In Indian agriculture it has been employed from the most ancient times as a shade-tree. It was a universal belief that the soil benefits by its presence, and it has been known for centuries that other leguminous plants also have beneficent effects on the ground in which they had been cultivated. The Romans were aware of the fact that cereal crops grow better in soil which has been under vetches the year before, and they made use of the knowledge in their system of rotation. It was only about fifty years ago that nodules were discovered on the roots of leguminous and certian other plants which contain large numbers of a living organism—a species of bacterium (*Bacterium radicicola*). These possess the power of fixing atmospheric nitrogen.

In some districts of Bengal the Betel-nut Palms are planted in groves of *Erythrina indica*. These enrich the soil, afford shade from the intense heat, and protection from sudden wind storms. Coffee planters in Assam appreciate, for the same reason, several species of *Erythrina*—(*E. indica*, *E. subumbrans* and *E. suberosa*). Also Tea-plantations derive advantages from the presence of *Erythrina*. In Ceylon it is planted for fences. The wood is white, light and soft (called Mochi-wood in Madras). It is much used for toys, scabbards, light boxes, trays, jars and planking. It does not warp or split and varnishes well. Much of the lacquered ware in different parts of India is made of it.

In Ceylon the young tender leaves are eaten in curries. The bark is used as a collyrium in ophthalmia (Haines).

The following varieties or forms of *Erythrina indica* are grown in Indian gardens :—

Var. **picta**, Hort.—*Erythrina picta*, Linn. Sp. Pl. ed. ii, 793 (*non* Wall.).
The leaves are variegated.

Var. **parcellii**, Hort.—*Erythrina Parcellii*, Bull. in Gard. Chron. ii (1874), 392, f. 82.
Has leaflets with variable yellow variegation. The flowers are bright cinnamon-red.
This plant is very showy when young and is easily propagated by cuttings.

Var. **marmorata**, Hort.—*Erythrina marmorata*, Veitch ex Planch. in Fl. des. Serres, xxiii (1880), 21.
It has large leaves attractively spotted with white.

Var. **alba.**
This is a white-flowered form.—Nairne (Flowering Pl. of W. India, p. 87) mentions it as occurring in Salsette, near Bombay. We have seen a specimen in the Victoria Gardens of Bombay.[1]

2. **Erythrina stricta**, Roxb. Hort. Beng. (1814), 53 ; Baker in Hook. f. Fl. Brit. Ind. ii, 189 ; Bedd. Fl. Sylv. t. 175 ; Brandis Ind. Trees (1911), 227 ; Talbot For. Fl. Bomb. i (1909), 402 ; Cooke Fl. Bomb. i, 367 ; Watt. Dict. Econ. Prod. iii, 270.
Micropteryx stricta, Walp. in Linnæa, xxiii, 740.
Popular Names : Taung Kathit (Burm.) ; Katiang (Lepcha) ; Fullidha (Nep.) ; Murukhu (Tam. Mal.) ; Mouricou, Kichige (Kan).
Description : A large or moderate-sized tree. Stems with a rougher bark than in *Erythrina indica*. Bark pale, smooth, greenish after the papery exfoliation. Branches armed with numerous sharp, yellow or whitish prickles. Leaves with prickly stalks sometimes 6 in. long ; the two small leaflets at the base of the leaf-stalk sickle-shaped. Calyx $\frac{1}{2}$ in. long, entire at the tip, but splitting to the base down the back, almost hairless. Corolla bright scarlet.

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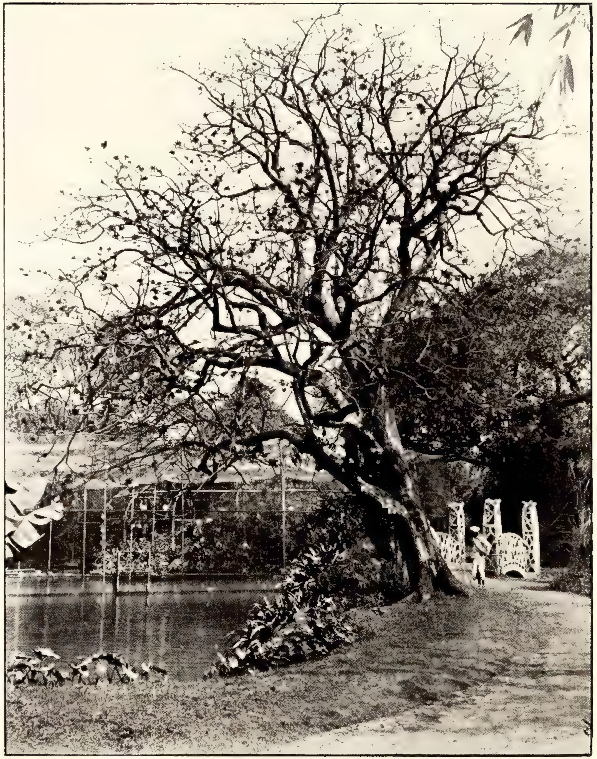
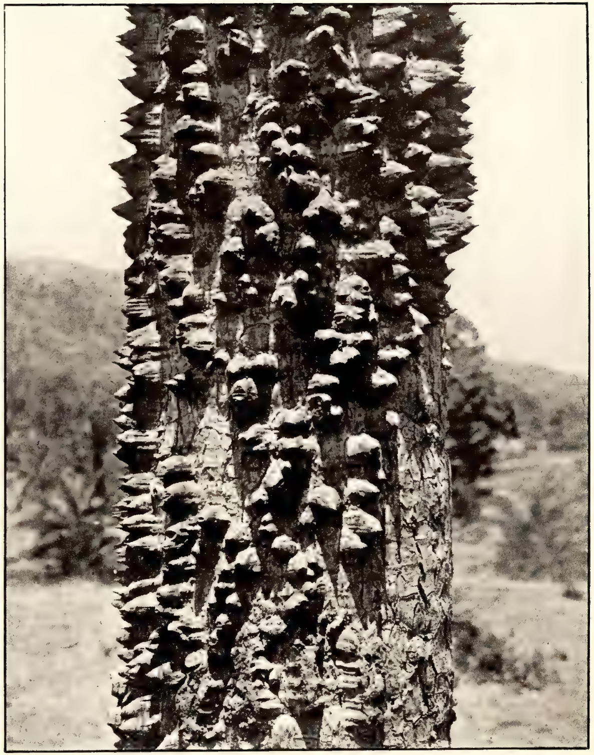
[1] Sir George Birdwood, in his book ' Sva ' (pp. 32-33) mentions that the white variety of the *pangri* (*Erythrina indica*) was first discovered near the ruined Hindu temple at Chimbur (Near Trombay—Bombay Suburban District) by a Mr. Bhasker, the *karbhari* of the Victoria Gardens. He claims that he himself was responsible for propagating innumerable cuttings from this tree in the Victoria Gardens, Bombay, and for distributing them widely, even so far as Egypt.

According to him this was the only place in the world where the white variety existed, and seemed to him, for what reasons he does not state, ' a distinct relic of the ancient Buddhists, who, as their grove at Lanouli (W. Ghats) shows, were enthusiastic arboriculturists '.

In addition to the Victoria Gardens and other localities in Bombay, the white variety may, at the present day, be found growing in the Empress, Bund Gardens, Poona and in the Native lines at Satara. *EDS.*



The Coral Tree (*Erythrina indica*) in flower.



The prickle-covered stem of the Silk Cotton Tree (*Bombax malabaricum*).

Pod 5–6 in. long, narrowed at both ends, slightly or not at all constricted between the seeds, compressed, stalked, hairless, often beaked with the slender style. Seeds 1–3, light brown.

Flowers : January to May.—The tree is without leaves up to the time of flowering.

Distribution : Assam, Manipur extending westwards to Nepal, Chittagong, Burma, Orissa, deciduous mixed forests of N. Kanara and the Konkan

Uses : The wood is white, soft and spongy but tough and fairly durable, weighs about 20 lb. per c. ft. It is used for fishing net floats on the W. coast of Madras, in the Bombay Presidency for scabbards, planking, and boxes to be covered with lacquer.

3. **Erythrina mysurensis,** Gamble Fl Madras 354, in Kew Bull. (1919), 222.

Description : A tree, branchlets apparently without prickles. Leaf-stalk 4 in. long ; stalks of leaflets $\frac{1}{3}$ in. long. Leaflets almost leathery, broadly egg-shaped, abruptly long-pointed at the tip, terminal one 5 in. long, $3\frac{1}{2}$ in. broad, lateral ones 4 in. long and about 3 in. broad, flowers fascicled towards the tips, scarcely $1\frac{1}{5}$ in. long, coral-red. Calyx split half-way down, minutely toothed above.

Nearly related to *E. stricta,* but the flowers are smaller, the wings and keel-petals are of the same length, i.e., $\frac{1}{2}$ in., the stamens are in two bundles.

It resembles *E. indica* in having the wings and keel-petals equal length, but the flowers are very much smaller and the leaves are different.

Flowers : November.

Distribution : Chickenalli in Mysore.

4. **Erythrina fusca,** Lour. Fl. Cochinch. 427.

Erythrina ovalifolia, Roxb. Hort. Beng. (1814), 53, Fl. Ind. iii, 254 ; Wight Ic. t. 247 ; Bedd. Fl. Sylv. 88 ; Baker in Hook. f. Fl. Brit. Ind. ii, 189 ; Brandis Ind. Trees (1911), 227 ; Haines Bot. Bihar and Orissa (1922), 286.

Duchassaingia ovalifolia, Walp. in Linnæa, xxiii, 742.

Popular Names : Hari-kekra (Beng.) ; Kon Kathit (Burm.).

Description : A moderate-sized tree. Trunk and branches armed with dark brown or black or pale-coloured and black-tipped, very sharp prickles, arising from pyramidal corky tubercles, and often extending even to the leaves and leaflets. Leaflets 3, much longer than broad. Racemes lax, 5–10 in. long, several at the ends of branchlets. Flowers crimson, mostly 3 in a fascicle. Calyx bell-shaped, splitting irregularly into 2 or more unequal divisions, hairy. Pod 6–8 in. long, swollen, bearing seeds throughout, constricted between the seeds at least on one side, finely downy, containing 6–8 seeds.

Flowers : February to May.

Distribution : Silhet, Lower Bengal, Plains of Lower Burma, Ceylon, Malay Archipelago, Polynesia.

5. **Erythrina suberosa,** Roxb. Hort. Beng. (1814) 53 ; Bedd. Fl. Sylv. 87 ; Baker in Hook. f Fl. Brit. Ind. ii, 189 ; Brandis For. Fl. 140, Ind. Trees (1911), 227 ; Cooke Fl. Bomb. i, 367 ; Talbot For. Fl. Bomb. i (1909), 402, fig. 227 ; Parker For. Fl. Punj. (1918), 158 ; Troup Silvic. Ind. Trees i (1922), 265 ; Haines Bot. Bihar and Orissa (1922), 285 ; Gamble Fl. Madras (1915), 354.

Micropteryx suberosa, Walp. in Linnæa xxiii, 744.

Popular Names : Corky Coral tree ; Pangra, Pangara (Hind. Mar.) ; Dauldhak, Rungra, Rowanra, Madara (Hind.) ; Gulmashtar, Pariara, Thab (Punj.) ; Paldua, Chaldua (Ur.) ; Nasut (Oudh) ; Piri, Buru Marar, Pharar ; Baldia (Bihar and Orissa) ; Mulu Modugu (Tel.) ; Sambar (Bombay Bhil).

Description : A middle-sized tree, 40-50 ft. high. Bark corky, deeply cracked. Branches numerous, crooked, spreading, armed with stout, conical, yellowish-white prickles $\frac{1}{10}$ - $\frac{1}{4}$ in. long, which fall off after the third year. Leaves of 3 leaflets, usually unarmed, but sometimes with a few scattered prickles on the stalks. Leaflets pale, 3·6 in. long and broad, sometimes broader than long, all more or less hairless above, matted with grey cottony hairs beneath. End-leaflet rhomboid or egg-shaped. Racemes 1-4, forming dense heads near the ends of the branchlets, 2-4 in. long ; calyx bell-shaped, soon becoming 2-lipped, not splitting to the base. Corolla scarlet. Upper stamen free from low down. Pod stalked, 5-6 in. long and $\frac{1}{2}$ in. diameter, cylindrical, slightly constricted between the seeds, filled when young with spongy tissue between the seeds which finally drops out leaving the seeds attached to the margins of the grey, shining, valves. Seeds 2-5, pale brown or black, dull, kidney-shaped.

Flowers : March to June.—The pods ripen after May.—The old leaves are shed during the cold season. The young leaves appear in March and April, generally shortly before the flowers open.

Distribution : Wild in the Siwalik tract and lower Himalaya, from the Ravi to the Sarda, ascending to 3,000 ft., occasionally found at 4,000, Oudh, Agra district, Merwara, Burma, Bihar and Orissa, N. Circars, Central Provinces, Deccan in dry forests up to 3,000 ft., throughout the forests of the Bombay Presidency, common in some of the Khandesh forests, up to 3,700 ft. in the Akrani, not in the heavy rainfall zone, not uncommon in S. India. Frequently cultivated.

Uses : The wood is white, soft and light, but fibrous and tough. It weighs about 19 lbs. per c. ft. It is used extensively for scabbards, sieve-frames, jars for household purposes, and occasionally for planking. A good cordage fibre of a pale straw colour is obtained from the bark. The wood, ash, and bark are employed for dyeing, and the bark is also used in medicine (Haines).

Of *Erythrina suberosa* two varieties are sometimes distinguished :

Var. **glabrescens,** Prain in Journ. As. Soc. Beng. lxvi, pt. 2 (1897), 410 ; Duthie Fl. Upp. Gang. Pl. i, 239 ; Parker For. Fl. Punj. 152 ; Haines Bot. Bihar and Orissa Pt. iii, 285.—*Erythrina glabrescens*, Parkar in Ind. For xlvi (1925), 647.

The leaflets are as in type, but almost hairless beneath at an early stage. It can be distinguished from *E. stricta* by the areoles of the leaves being less conspicuous and not white.

Distribution : Hot valleys of the W. Himalaya from Bashahr (up to 7,000 ft.) eastward to Sikkim, also in Burma and on the Shan Hills.

Var, **sublobata,** Baker in Hook. f. Fl. Brit. Ind. ii, 190; Haines Bot. Bihar and Orissa, Pt. iii, 285.—*Erythrina sublobata*, Roxb. Fl. Ind. iii, 254 ; Bedd. Fl. Sylv. 87.—*Macropteryx sublobata*, Walp. in Linnæa xxiii, 740.—*E. tomentosa*, Ham. in Wall. Cat. 5964.

The leaflets are variously lobed or notched, very hairy beneath.

Flowers : At the end of the cold season. Seed ripens before the rains begin.

Distribution : Parasnath, Hazaribagh, Monghyr, in land mountains in the Circars.

6. **Erythrina arborescens,** Roxb. Cor. Pl. t. 219, Hort. Beng. (1814) 53. Fl. Ind. iii, 256 ; Brandis For. Fl. (1874), 140, Ind. Trees (1911), 227 ; Baker in Hook. f. Fl. Brit. Ind. ii, 190.

Popular Names : Rungara, Mandiara, (Kumaon) ; Rodinga, Fullidha (Nep.) ; Gyesa (Lepcha) ; Dingsong (Khasia).

Description : A low tree. Trunk straight, with no more than two or three simple ascending branches, armed with a few, scattered, small, sharp prickles, otherwise smooth in every part. Leaflets entire, smooth above, whitish underneath, the end-one nearly kidney-shaped. Flowers many, large, of a vivid scarlet, in threes, stalked, drooping over each other in an elegant way. Calyx entire, bell-shaped, coloured. Standard almost egg-shaped, boat-shaped, hanging over the rest of the flower. Pod much curved, ½-¾ ft. long, 1 in. or more broad, 4-6 seeded.

The flowers resemble those of *E. suberosa*, but the calyx is larger and the limb of the standard broader.

Flowers : August to October.—The flowers appear together with the leaves.

Distribution : Outer Himalaya from the Ganges to Sikkim at elevations between 4,000 and 7,000 ft., Melghat Berar, Khasia Hills. Occasionally planted in Sind and elsewhere.

7. **Erythrina subumbrans,** Merr. in Philipp. Journ. Sc. 112 (1910), 113.

Hypaphorus subumbrans, Hassk. Hort. Bogor. Desc. (1858), 198.

E. lithosperma, Blume ex Miq. Fl. Ind. Bat. i, 209 ; Baker in Hook. f. Fl. Brit. Ind. ii, 190 ; Kurz For. Fl. i, 367 ; Brandis Ind. Trees 227.

E. secundiflora, Hassk. Pl. Jav. Rar. 378.

Popular Name : Yekathit (Burm.).

Description : A tall tree, reaching a height of 45 ft., without or with a few straight sharp prickles. Leaflets membranous, dark green, egg-shaped, long-pointed, 4-6 in. long. Racemes of flowers appearing with the leaves, hairy, about 4 in. long. Calyx velvety, finally splitting down nearly to the base in two lips. Petals red, the standard about 1½ in. long, keel and wings less than half the length of the standard. Pod much bent back, 4–5 in. long, flat, seedless in the lower half, bearing 1-3 seeds at the tip.

Flowers : January, February.

Distribution : Burma, in moist valleys near streams up to 3,000 ft., Indo-China and Malaya.

Uses : Often grown to support the betel-vine.

'This tree in universally employed in the Java plantations as a shade tree for coffee, and, with *E. umbrosa*, H. B. K. from Central America and *E. velutina*, Willd. from the W. Indies, is used for the same purpose over cocoa in Ceylon.' (Gamble).

8. **Erythrina resupinata,** Roxb. Cor. Pl. t. 220, Hort. Beng. 53, Fl. Ind. iii, 257 ; DC. Prodr. ii, 410 ; Brandis For. Fl. 141. Ind. Trees 227 ; Duthie Fl. Upp. Gang. Pl. i, 238 ; Haines Bot. Bihar and Orissa, Pt. ii, 286.

Though the species is not a tree, but a herb or undershrub, we include it here, because it is one of the curious dwarf representatives of otherwise tree-producing genera. Similar instances occur in *Ochna*, *Grewia*, *Combretum*, *Careya* and *Premna*. Gamble is of opinion that they 'have become definite species through years of regular burning of the above-ground stems.'

Description : An undershrub with a perennial rootstock. Shoots a few inches high, dying down annually. Leaf-stalks long, prickly ; Leaflets 2–3 in. long and broad, round-heart-shaped, entire, nerves beneath sometimes prickly. Racemes direct from the rootstock, under one ft. high, dense and many-flowered, often appearing before the leaves; stalk prickly. Flowers bright scarlet, large, in threes. Calyx 2-lipped, bell-shaped. Standard oblong, 3–4 times the length of the calyx, keel half as long as the standard, tinged with red ; wings much shorter, greenish. Upper stamen free from low down. Pods stalked, about 3 in. long, flat, 3-seeded, constricted between the seeds.

Flowers : The flowers are produced in March after the fires of the hot season, and present a very beautiful appearance. After the flowers appears a short herbaceous stem which withers after the rains.

Distribution : Savannahs of the subhimalayan tract from Oudh and Gorakhpur eastward, also on Parasnath.

Introduced Species

Erythrina Crista-galli, Linn. Mant. i, 99.

E. laurifolia, Jacq. Obs. Bot. iii, 1.
E. fasciculata, Benth. in Linnæa, xxii (1849), 518.
E. speciosa, Tod. Ind. Sem. Hort. Panorm. (1860), 11.

Description : Bushy and woody, sometimes developing a very short trunk, but the flowering branches dying back after blooming, the stronger branches arising annually or periodically from near the root. Stem and leaf-stalks somewhat spiny. Leaflets egg-shaped oblong or lance-oblong, long-pointed, entire. Flowers large, brilliant crimson ; keel nearly as long as the down-folding standard ; wings rudimentary.

This plant runs into many forms, varying in theshade of red, some of them with variegated leaves.

It is a native of Brazil and has been introduced into Indian gardens.

According to Woodrow it thrives in any fair garden soil in the dry districts, and is easily propagated by cuttings.

Erythrina Blakei, Hort.; Parker For. Fl. Punjab, 159.

Description . A small tree or large shrub ; bole thick and crooked ; branches massive, spreading ; bark grey, smooth ; prickles very few. Leaflets round or egg-shaped, long-pointed, hairless, 3–4 in. long. Racemes terminal, leafy below with distant flowers, densely flowered above. Calyx bell-shaped, slightly 2-lipped, hairless. Corolla dark scarlet, 2 in. long ; standard ⅘ in. broad ; keel less than half as long as the standard ; wings narrow-oblong, as long as the keel or nearly so.

Parker says that this plant is cultivated in gardens all over Northern India under the name given above. He thinks it might be a hybrid or form of the American *Erythrina herbacea*, Linn.

Bombax, Linn.

(From the Greek *bombux*, signifying raw silk.)

The genus *Bombax* belongs to the family *Bombacaceæ*, formerly included under the *Malvaceæ*. It comprises about 60 species, indigenous chiefly in Central and South America, A few are found in the Tropics of the Old World.

They are desiduous trees with digitate leaves. The flowers arise from the axils of the leaves and are gathered at the ends of branchlets. The calyx is leathery, cup-shaped and splitting irregularly. The petals are 5. The stamens are many, inserted at the base of the calyx, united into 5 bundles opposite to the petals. The fruit is 5-celled; the cells are thickly clothed inside with long silky hairs, in which the seeds are embedded in dense wool.

Key

I. Stamens 60–70	*B. malabaricum.*
II. Stamens about 400–600	
1. Flowers scarlet or white	*B. insigne.*
2. Flowers salmon-pink	*B. scopulorum.*
III. Stamens about 350	*B. anceps.*

1. **Bombax malabaricum,** DC. Prodr. i (1824), 479; Wight Ill. t. 29, Bedd. Fl. Sylv. t. 82; Brandis For. Fl. (1874), 31, Ind. Trees (1911); 77; Gamble Ind. Timb. (1902), 90; Cooke Fl. Bomb. i (1903), 120; Talbot For. Fl. Bomb. i (1909), 130, figs. 79, 80; Parker For. Fl. Punj. (1918), 42; Gamble Fl. Madras (1915), 99; Watt. Dict. Ec. Prod. i. 487; Troup Silvic. Ind. Trees i (1921), 135.

Salmalia malabarica, Schott. & Endl. Meletem. 35.

Bombax heptaphyllum, Cav. Diss. v, 296; Roxb. Hort. Beng. 50, Cor. Pl. iii, t. 247, Fl. Ind. iii, 167.

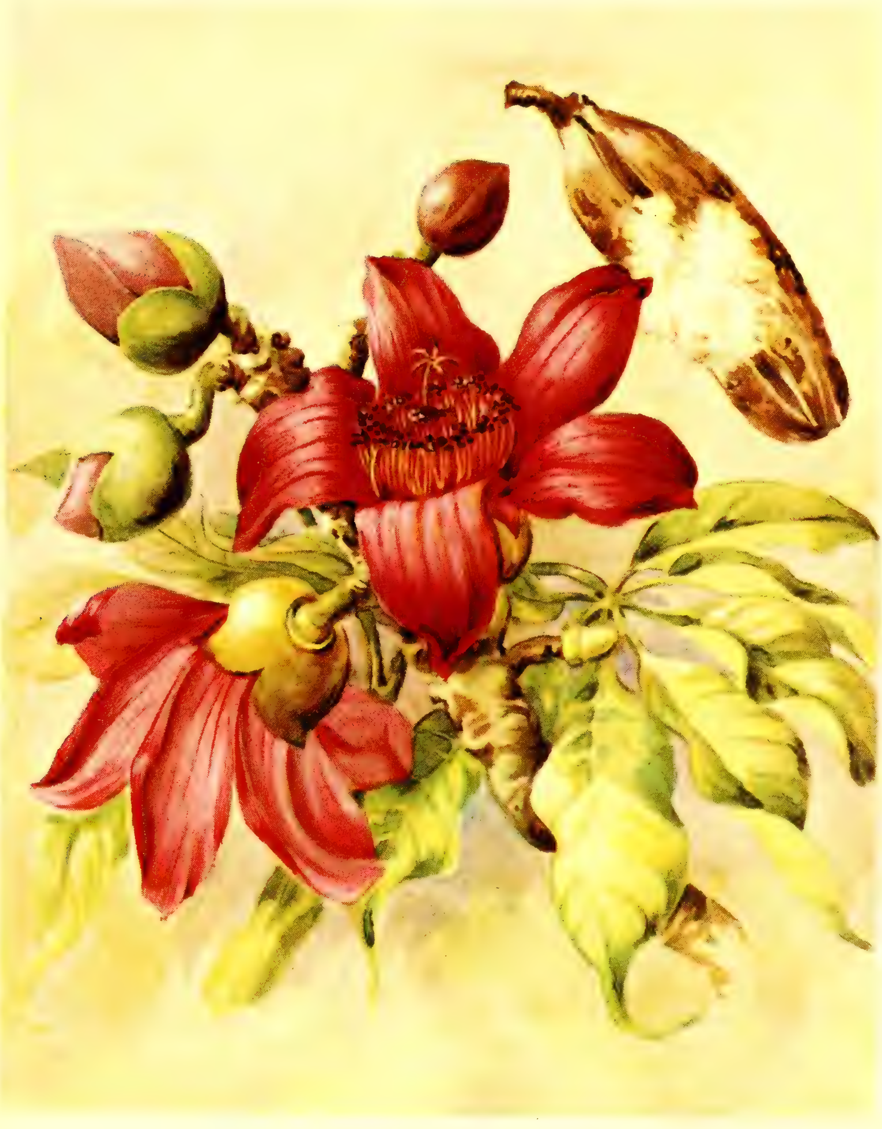
Bombax Ceiba, Burm. Fl. Ind. 145 (*excl. syn.*).

Gossampinus rubra, Ham. in Trans. Linn. Soc. xv, 128.

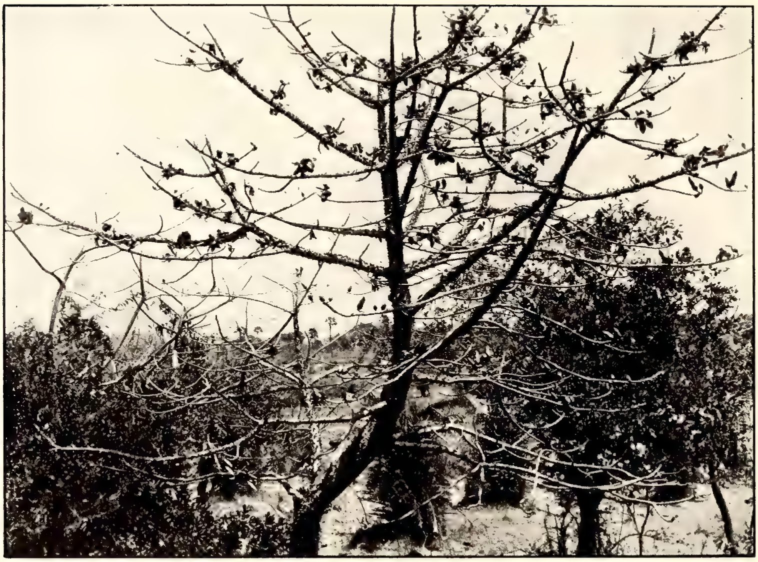
Rheede Hort. Malab. iii, t. 52.

Popular Names: Cotton tree, Silk-cotton tree, Red cotton tree; Simal, Shembal (Hind.); Burla, Sauri, Buruga (Kan.); Kate-Saveri, Savar, Saur (Bomb. Pres.); Sayar (Mar.); Buroh (Ur.); Sawar (Guj.); Illavam, Pula, Parutti (Tam.); Ilavu (Mal.); Letpan (Burm.): Simbal (Hazara); Shirlan (Sutlej); Shimlo (Kumaon); Shimal (Gharhwal); Bouro, Buroh (Uriya); Bolchu, Panchu (Garo); Sunglu, Tunglu (Lepcha); Simal, Saodi (Melghat); Khatsawar (Bassim); Kamba (Khond); Buroh (Saora); Wuraga (Palkonda); Edel (Sonthal); Del (Kol); Simur (Mal Pahuri); Wallaiki (Gondi); Katseori (Bhil); Lapaing (Magh); Katu-imbul (Cingh).

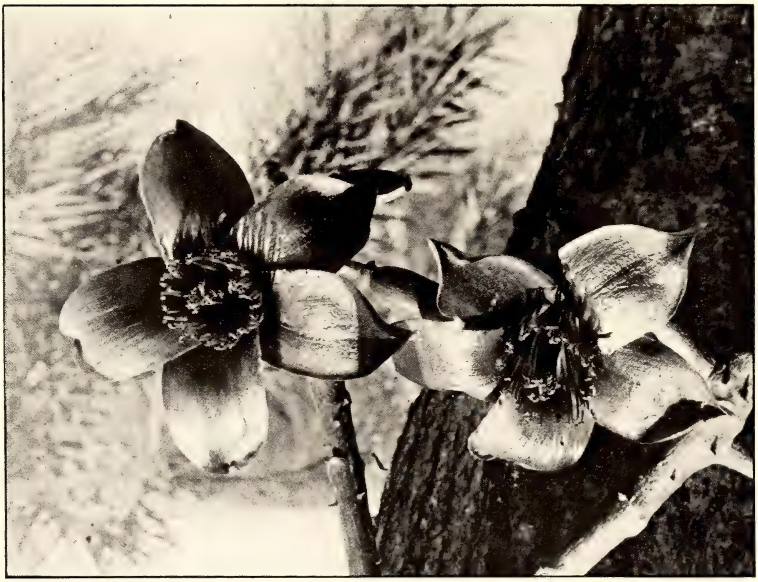
Description: A tall deciduous tree with wide spreading branches arranged in whorls. The stem is usually undivided and is generally supported at the base with large buttresses. The colour of the bark is grey; it is covered with sharp, conical prickles which disappear with increasing age. The leaf is large and hairless. It is composed of from 3 to 7 long, lance-shaped, more or less leathery leaflets, arranged like the fingers of a hand on a long common stalk. The



SILK COTTON TREE
Bombax malabaricum, DC.



The Silk Cotton Tree (*Bombax malabaricum*) in flower.



Photographs by C. McCann.

Flowers of the Silk Cotton Tree (*Bombax malabaricum*).

diagram illustrates the shape and arrangement of the leaflets. The crimson flowers are large and numerous. They grow in clusters on short, thick stalks, towards the ends of the branches and appear before the new leaves. Occasionally the flowers are yellowish or white.

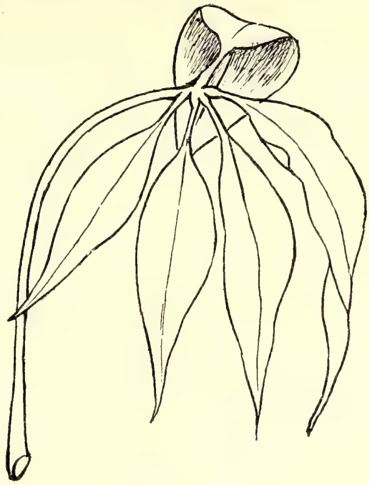


FIG. 3.

Calyx thick, fleshy cup-shaped, smooth outside, bright silky hairy within. The petals are hairy on the outside, slightly hairy within. They are fleshy, bent back and marked with close parallel veins. The petals may be from 3 to 6 in. long. The stamens, of which there are more than 60, are pink, flattened, slightly hairy, rather more than half as long as the petals. They are united only at the base to form 5 separate bundles containing from 9 to 12 stamens each. There is in addition, an inner bundle of 15 stamens of which the 5 innermost are the longest; the anthers are long and brown. The accompanying drawing of a longitudinal section of the flower illustrates its general shape and the arrangement of the inner organs. The ovary is conical in shape. It contains 5 cells, each holding many ovules. The ovary tapers at the apex to form a club-shaped style which exceeds the stamens in length and ends in 5 slender projections—the stigmas.

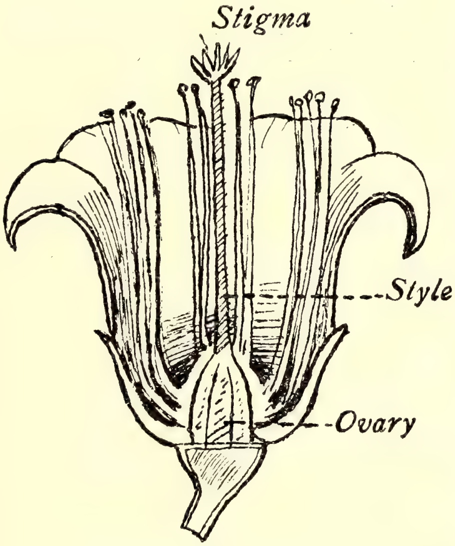


FIG. 4.

The fruit attains a length of 4–5 in. It is oblong-egg-shaped, downy without and lined within with white silky hairs. It contains many dark brown seeds packed in white cotton.

Leaf-shedding: In dry localities the trees start shedding their leaves at the beginning of December and are leafless by the end of that month. In moist localities the trees may keep their leaves till March. The new leaves make their appearance in March and April.

Flowers: The large dark brown buds become visible in the month of December and the flowers come out in January and February, and sometimes continue till March. At the time of flowering the trees are usually leafless, but when flowers and leaves appear at the same time, the flowers are usually, less numerous.

'The trees when in full flower present a striking blaze of colour; the fleshy petals are attacked by crows, minahs, and other birds, and when they fall to the ground they are eagerly devoured by deer. I have observed squirrels (*Sciurus maximus*) eating the flower-buds in quantities. Pollination is effected by bees, which visit the flowers in large numbers, as well as by birds, which seek the nectar or search for insects, and get their heads covered with pollen. Even martens (*Martes flavigula*) have been observed visiting the flowers in search of nectar.' (Troup).

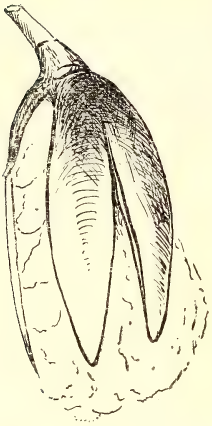


FIG. 5.

Fruits: They ripen in April and May. Usually they open whilst still on the tree, but sometimes after falling. As the seeds are packed in masses of silky hairs they are easily blown about by the wind.

Distribution: Indigenous throughout India and Burma, except in the most arid tracts. In the subhimalayan tract it extends from the Indus eastwards, ascending to 3,500 ft. in the N. W. Himalaya, and is cultivated as high as 6,000 ft., very common throughout the Bombay Presidency, in the Satpuras in exposed situations on hard trap-rock at 3,700 ft., in all forest districts of the Madras Presidency.—Also in Ceylon, Yunnan, Cochin China, Tonkin, Siam, Java, Sumatra, Queensland and N. Australia.

Uses: The wood is not durable, except under water where it lasts fairly well. It is used for boxes, tea-boxes, planking, lining of wells. In Bombay, Bengal and Burma the trunk is often hollowed out to make canoes. From the wounds in the bark there exudes a brown gum, Mocharas or semul-gum, which is used in Indian medicine. The silky floss which clothes the seeds is used for stuffing pillows and cushions. The calyx of the flower is eaten as a vegetable.

2. **Bombax insigne,** Wall. Pl. As. Rar. i (1830), 71, tt. 79, 80; Kurz in Journ. As. Soc. Beng. ii (1873), 61, For. Fl. i, 130; Masters in Hook. f. Fl. Brit. Ind. i, 349; Gamble Ind. Timb. 91, Madras Fl. (1915), 100; Cooke Fl. Bomb. i, 120; Talbot For. Fl. Bomb. i, (1909), 132; Brandis Ind. Trees (1911), 77; Troup. Silvic. Ind. Trees i (1921) 145 (*partim*).

Bombax insigne subsp. *genuina* var. *Wightii*, Prain in Journ. As. Soc. Beng. (1903), 62.

Popular Name: Didu (Burm.).

Descrption: A very large tree, with more or less prickly bark. Leaves hairless, long-stalked; stalks as long or longer than the leaflets, leaflets 5–9 or more, 5–6 in. long, inversely egg-shaped, narrowed at the base; stalks of leaflets $\frac{1}{5}$-$\frac{1}{3}$ in. long. The foliage of this species is difficult to distinguish from that of *B. malabaricum.* Flowers larger than in the previous species, solitary, on a thick, club-shaped, prickly stalk which is jointed at the top. Calyx $1\frac{1}{2}$ in. long, irregularly splitting at the top and finally deeply 2-cleft, sometimes prickly at the base outside, densely silky-hairy within. Corolla snowy, scarlet or white; petals long, strap-shaped, 5 in. by $\frac{1}{2}$ in., narrowed at the base, densely tomentose on both surfaces. Stamens 400–600, arranged in bundles, but not so distinctly as in *B. malabaricum* ; filaments filiform, 3 in. long, forked at the tip. Ovary egg-shaped, red-hairy. Style longer than the stamens ; stigma 5-lobed. Fruit a capsule, long, sausage shaped, woody 7–10 in. long, obscurely 5-angular, hairless.

Flowers and *fruits* at the same time as *B. malabaricum.*

Distribution : Burma, Pegu, Andamans, common on the Ghats of the W. Peninsula from the Konkan southwards, gregarious in N. Kanara from the coast upwards to the crest of the Ghats, also in the Konkan and Deccan districts, Anamalai Hills.

Uses : The wood is more durable than that of the ordinary silk-cotton tree. The c ft. weighs 31 lbs.

3. **Bombax scopulorum,** Dunn in Gamble Madras Fl. (1915), 100, in Kew Bull. (1916), 65.

Bombax insigne, Bourdillon Forest Trees Travanc. 45 (***non*** Wall.).

Popular Names : Kal ilavu, Parei-ilavu (Tam., Mal.).

A small tree, having the appearance of the ordinary cotton tree, but never attaining its size, about 40 foot high, 1 feet diam ; stem covered with prickles in clusters of 1-12, about ¾ in. long. Leaves of 6–8 stalkless leaflets, 5–9 by 1–2 in., lance-shaped, dark green and hairless above. Flowers salmon-pink, 4 in. across, 7 in. long, solitary, appearing before the leaves. Stamens about 600, slender, white. Style simple. Fruit 7–10 in. long, velvety-brown. Seeds black, smooth, ¼ in. diam., packed in white cotton.

Flowers in December to January.

Fruits January to February.

Distribution : Travancore Hill, on rocks.

4. **Bombax anceps,** Pierre Fl. For. Cochinch. (1888) t. 175 ; Brandis Ind. Trees (1911), 78.

Bombax malabaricum subsp. ***anceps,*** Prain var. *vera,* Troup Silvic. Ind. Trees i (1921), 145.

Popular Names : Didu Letpan, Kokye (Pegu) ; Didu-pya, Didok (Burm.) ; Kowa (Karen.).

Description : A lofty tree, reaching a height of 100 feet and a girth of at least 16 feet. Bark greyish, more or less prickly when young. Leaflets 5–7. Petals red or white, 3 in. long, slightly hairy on both faces. Stamens about 350, tube formed by the stamens ¼ in. long. Style hairless. Fruit a capsule, woody, dark brown, 3¼–4 in. long with 5 very prominent rounded ridges.

Distribution : Burma (Pegu and Arakan Yoma, Upper Burma, N. Shan States, Salween), Cochin China.

(*To be continued.*)

BOMBAY NATURAL HISTORY SOCIETY'S MAMMAL SURVEY OF INDIA, BURMAH AND CEYLON

Report No. 46 (Supplementary)

ON THE SECOND, THIRD AND FOURTH COLLECTIONS FROM TOUNGOO, BURMAH, MADE BY MR. J. M. D. MACKENZIE, I.F.S., BETWEEN DATES FEBRUARY 9, 1927 TO MARCH 2, 1928

BY

T. B. Fry

In the Report (No. 46) for the first of the series of collections made in the Toungoo District no attempt was made to describe the character of the country worked over, and this no doubt may have been considered a defect by some readers of the Journal. However, Mr. Mackenzie has now furnished the Society with data on this subject in addition to many interesting notes on the habits of various animals observed by him, together with information of a similar kind gathered from local native hunting and cultivating people. The omission noted above will therefore be best rectified by the inclusion of these notes in full in this supplementary report, which deals with practically all the animals referred to in the original report.

The notes relating to sundry animals are of special value since in some cases they confirm the published views of former observers, while in others they indicate that mistaken ideas have sometimes been adopted.

Two further points only seem to call for remark in these three collections; one being that Mr. Mackenzie has scored a success in obtaining another specimen of what appears to be a rare bat '*Rhinolophus affinis tener*', and secondly attention may be drawn to the fact that Toungoo, Pegu and the Shan States appear to form a meeting ground for several of the Northern and Southern Burmese forms of mammals, such as for example *Cynopterus sphinx* and *Cynopterus brachyotis angulatus*, *Tamiops m. manipurensis*, *macclellandi*, and *m. barbei*, possibly also *Herpestes birmanicus* which differs but little from *H. nepalensis*. This fact gives rise to doubts whether some of these animals to which specific names have been accorded, may not eventually be regarded as merely local races.

Notes on a Collection of Mammals from Toungoo, Burmah

Nos. 879 to 1489 (About)

Area concerned.—The area concerned is that part of the North Toungoo Forest Division, lying between the top of the ridge of the Pegu Yoma on the West and the West boundary of the unadministered Karen hill tracts on the East, a line running about 15 miles

East of the Sittang River, which is the main river in the area. It is roughly rectangular, 35 miles from North to South and 40 miles from East to West. Between longitudes 95° 50′ and 96° 30′ East and latitudes 19° 30′ and 18° 55′ North. The Burma Railway line from Rangoon to Mandalay runs the whole way a mile or so West of the Sittang River. It really forms a continuation of the collections made in South Pegu (No. 28) and Prome. South Pegu is the drainage of the Pegu River, extending to the sea in the South as far East as the Sittang. There is a gap of about 80 miles between this area and the present one. The Prome collection was made in the extreme Northern part of the drainage of the Rangoon River (including Prome itself in this, though it is on the Irrawaddy) East to the Pegu Yoma ridge. Though this area is actually some 30 miles South of the present one, it gives a fair representation of the Western slopes of the Pegu Yomas, while the Toungoo and Pegu collections give the Eastern slopes. The Toungoo collection differs from the Pegu one in covering a certain area East of the Sittang River. The grey squirrel, *Tomeutes phayrei*, was found exclusively on the East bank; while *rufigenis* (Nos. 1479, 1484, 1485, etc.) was only found in the Karen hills on the East. There may well be other differences in the fauna East and West of the Sittang, which is big enough to form a barrier, with the strip of paddy cultivation on both banks.

I enclose notes[1] from the Gazetteer; but the division may roughly be described as a patch of paddy cultivation either side of the Sittang, with jungle beyond it in both directions. On the west, this jungle is mainly moist deciduous forest, with patches of dry jungle of which *Dipterocarpus tuberculatus* is typical (Burmese In, or Eng, the type of jungle being called 'Indaing') near the Railway. There are considerable areas of reserves, one patch along a ridge some 5–10 miles West of the Sittang, the next on the Pegu Yomas slopes, with a 10 miles strip of unclassed forest in the valley between, in which there are villages and a good deal of cultivation, permanent and shifting (Taungya). On the East there is a strip of reserves, moist deciduous forest with considerable patches of Indaing on the West beyond which lie the Karen foothills in which most of the cultivation is Taungya, except for extensive betel gardens, mostly terraced and irrigated. To the extreme East lie the Karen hills, with Thandaunggyi, the highest point 4,822 ft. above sea-level. Hilly, broken country continues into Karenni, where Fea collected, some 15–20 miles to the East, but no specimens in this collection come from further East than Thandaung. To the South and East of the area lies Shwegyin, the ' Schay Gyeen ', etc. of Blanford.

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[1] From the Gazetteer, Toungoo District (1914).

Note.—These refer to the district of which the N. Toungoo Forest Division is only the Northern part.

'The rocks of the Pegu Yoma are, so far as is known entirely of tertiary age, consisting of miocene beds of shale and sandstone belonging to the Pegu group. The ranges to the East of the Sittang are far more ancient and are composed principally of crystalline gneissic rocks. In the N.E. of the district there are outcrops of harder rocks of a granitoid type. The centre of the district consists of the Sittang alluvium merging in the N.W. into fossil wood beds, which are almost entirely denuded. Large quantities of limestone are found in parts of the N. Toungoo division. . . . (There are also beds of laterite. *D.M.*)

Fauna :—Animals (*sic.* i.e. mammals. *D.M.*) Those not mentioned already in my notes are :—Clouded Leopard ; bear (2 kinds) Serow and Gooral occur in the Eastern hills, but unless exceptionally, not in the Pegu Yomas ; other animals found are Wild dogs (two kinds) (I doubt this. *D.M.*). . . .

Rainfall is said to decrease from S. to N., i.e. Yedashe, 20 miles N. of Toungoo, and about half way through the area is given as 70″ only. This is as would be expected, but is not necessarily an indication of the fall in the jungle clad slopes on either side of the valley. *D.M.*

The forests on the E. slopes of the Pegu Yomas are of a moister type than those on the W. (Prome). *D.M.*

Toungoo itself is 166 miles north of Rangoon and is on the extreme South of the area.

In addition to the Railway, there is a certain amount of small boat traffic on the Sittang, and there are trade routes running to the East on which pack bullocks are the chief form of transport. There is the Mandalay-Rangoon road, running North and South along the Railway which is only now in process of being metalled, though it has been in use for carts for many years. The only other metalled road of any length in the area is the Thandaung road, from Toungoo to Thandaung, 30 miles almost due East (about 18 miles as the crow flies) all except the first 5 miles running through a strip of reserved forest. At Thandaung, there is a tea estate, and there are rubber estates elsewhere East of the Sittang. Conditions vary considerably ; rainfall is 87 inches in Toungoo and 225 inches in Thandaung, 18 miles away, but 4,500 ft. higher. Toungoo itself is only about 100 ft. above sea-level. The Pegu Yoma ridge runs up ot 2,000 ft. and the Karen hills on the East vary from 4,822 ft. to say 2,000 ft. with deep valleys between the peaks.

The climate is that common to Lower Burmah, though the dry zone with semi-arid conditions, begins not very far North. The inhabitants on the West differ little from those of Prome and Pegu as far as their effects on the fauna are concerned and generally speaking as might be expected, the fauna is similar. On the East, however the country is inhabited by a very backward class of hill Karen practising shifting cultivation in the main, and inveterate hunters. I have seen no country in which animals are so scarce except the Chin Hills where conditions are in many ways similar. The result is seen in the scarcity of all mammals on the East bank at any distance from the river. At Thandaung in 14 days collecting only 13 specimens were obtained and though during four days in November we had a mist most of the time and in April were hunting for eggs, I have no hesitation in saying that mammals are far scarcer in the Karen Hills than elsewhere. The older inhabitants say that monkeys used to be comparatively common ; that is, they were generally to be seen or heard near the road. We saw one only and the pace at which it made off was eloquent of its desire to avoid human beings. My collector saw it and says it was darkish brown different from anything we had got ; he had no time to see anything else.

Presumably the reason for this scarcity is to be found in the increase of guns, and in the security enjoyed under British Rule, which allows all and sundry to go hunting in safety whenever they feel like it.

The following animals are said to exist in the area but are not represented in the collection :—

1. *Gibbons*.—Said to have been found in the Karen Hills in the past. None heard or seen. None in the Pegu Yomas.

2. *Tiger*.—Occurs throughout the district. Believed to be on the increase, on account of increased depredations amongst domestic animals, but I think this is largely due to the decrease of game and hunting areas due to the spread of cultivation. The same remarks apply to leopards.

3. The less common forms of small Carnivora are not easy to get. There are certainly some which are not represented. I heard of an *Arctonyx* being caught, but failed to get hold of it.

4. *Otters*—Certainly occur. I have seen tracks and have heard of at least one being shot. We failed to get a specimen, though they are said to do considerable damage in certain fisheries.

5. I was told on very reliable authority that a cat bear had once been seen hanging round a kill in Thandaung. It was not shot, and I think (partly because the beast is said to be strictly vegetarian in its diet) there must be some mistake. It is very difficult to identify an unknown animal from a description.

6. *Bamboo Rats*—There is said to be a big bamboo rat ' about the size of a hare ' in the Karen Hills. I failed to get any specimens.

7. *Porcupines*—I have found spines and deserted burrows.

8. *Elephant*—One herd of about 20 in the North-West, occasional rogues elsewhere.

9. *Rhinoceros*—One reported to turn up periodically. I have no doubt that he wanders over a considerable area, and is probably reported from at least 2 other areas and counted as three beasts instead of one.

10. *Bison*—Occur.

11. *Saing*—Occur. They had been driven away from the area where concentrated extraction of hardwoods was in progress but are now coming back into closed areas after 6 or 7 years.

12. *Serow* :—Reported to occur, but I have never seen signs of them.

13. *Thamin*—(Eld's deer) I have neither seen nor heard of these. They occur to the North of the area.

14. *Pangolin*—I have heard of them, but not seen them. I got a specimen in Pegu.

General Notes. Wherever possible, I have sent fœtuses.

Nos. 1085 and 1088 were entirely omitted in error.

Nos. 1376–1380 and 1478–1486 come from Thandaung 4,500 ft. about. Thandaunggyi is merely a point of rock—20 yards square on the top. *Homo sapiens* inhabits almost at the extreme top—say 4,810 ft. where there is a cave to which a local holy man retires for meditation. I tried to get along the ridge to Leiktho (22 miles north) but a broken path in a steep hillside would not let my elephants across in safety. I may be able to manage it next year, when I hope to improve the collection of these ' Hill ' things.

No. 1489 (a bat) is from Maymyo, caught in a house at night.

It will be noted that the Burmese names are very 'unstable'. Except for animals (including birds) which are either common, or conspicuous or used for food, Burmans do not have any fixed names, or if there is one, the average jungle Burman does not know it. A man with a reputation to keep up promptly coins one if asked. My own collector and I have a series of names by which we know the various animals, but I question whether anyone else would recognize them, e.g. 'the striped squirrel' is *T. macclellandi*, the 'big striped squirrel' *M. berdmorei*. The small carnivora which are not dogs or otters are almost universally 'Kyaung' or cat to the normal Burman; a Tupaia is a squirrel though the Chins have a name for it in the Chin Hills, and this leads to another point. It is the less civilized races, such as Chins, Kachins and Karens who have to depend largely on hunting for their food and consequently have names to distinguish the various species.

In the Prome and Pegu collections (excluding bats) 4 species occur which are not included in the present one. *Pithecus melamerus* (N.B. now *P. pyrrhus shanicus, T. B. F.*) *Arctogalidia leucotis*, a Serow and a Pangolin. The first may be the form from the East slopes of the Yomas, but this hardly seems a convincing distribution, and I have heard of a *Semnopithecus* here said to be distinct from the one obtained in the arrangement of hair on the head, but have been unable to get a specimen.

Shooting at night. A hint which may be of use to others is the use of an electric torch at night. All my flying squirrels were obtained this way, their eyes showing up bright red. Many of the civets, etc., were shot in the same way in various fruit trees.

NOTES ON SPECIMENS

(B = Burmese).

Macaca mulatta.—956, 1148, 1149, 1150, 1322, 1323.

B. *Myauk pin-ne.* (1322 East bank '*Myauk Nee*').

No. 1149 (May 15, 1927) had a young one, about 6 weeks old, still hanging to her. It was caught and got quite tame, too tame, as it was killed by a passing pi-dog.

No. 1322 had No. 1323 and another young one (which got away) with it. I have usually met with them close to cultivation, as opposed to *Semnopithecus*, found in heavy jungle away from villages, usually found in herds of 20–30 or more. Nothing to add to Blanford *re* habits.

Pithecus.—Nos. 1115, 1116, 1420, 1422, 1423, 1426, 1499, 1434.

B. *Myauk-Nyo.*

No. 1429 was found alone in a stream much lower down than usual and alone. 'Orbits white, with blue skin round.'

Usually found in dense high forest in parties of about 20. It is usually the males which are shot, as the females make off at once with their young, on being alarmed. I have twice shot with a rifle (they know the range of a gun, I am sure) males who stayed behind in a very high tree, barking. The whole party in moving follows the same route, running along the same branches and jumping from and to the same spots, often stopping at the same places for a look back, a useful habit to the collector. Their leaps look tremendous, they seem usually to jump into a group of branches or the top of a lower tree rather than on to a particular branch, spread-eagling themselves so as to distribute the weight. The tail seems of use in balancing.

I have noticed the same trait of sticking to the same route in gibbons and macaques in Katha. I was in camp not far from a *Ficus* in fruit. The first day, 4 or 5 gibbons came to it, the next 20 to 30 macaques. In each case, once they got back from feeding, to certain fixed points all the beasts followed the same route, though this route was different for the two species.

All my specimens are from the West bank, but I saw a party on the East bank one day ; they were very shy, but I had a rifle, and was firing at a stopping point. They are not a very big mark from the shoulder in a high tree, but I must have been very close to one, which fell at least 100 feet, breaking the fall somewhat with branches. It lay still for a bit and I thought it was dead. While I was trying for a second, it suddenly got up, went like a lamplighter and cleared out. I think it cannot have been hit, as there was no blood, but I have never before heard of one falling.

3. *Nycticebus coucang*. 1482. B. ?

This specimen was caught on the tea estate in Thandaung, at 4500 ft. It must have been benighted-or rather be-dayed. I got another about a week before near Toungoo, and still have it alive. It is in all respects similar to the skin, except that the brown stripe and spectacles are perhaps more distinct. I was offered another, but really hadn't the heart to chloroform it. During the day it is inconceivably slow in all its movements absolutely like a slow motion picture but it speeds up considerably at dusk. It feeds on rice, fruit and any insects it can get hold of, though I have found several which it rejects absolutely. Large longicorn beetles and blattidæ seem to be its favourites. It will cling to a branch with its hind legs, and stretch out almost to its full length to grab an insect, which it almost invariably seizes with its hands. It approaches them very slowly with a final grab which might be mistaken for a pounce. I have never seen it actually pounce, or 'throw itself on an insect'. It can cling desperately tight as I found when changing cages. It can also give quite a nasty bite. Its method of seizing prey is a clutch mainly with the fingers and palm as opposed to a hold with the thumb. But the thumb is used in gripping a branch, in moving being opposed to the fingers. So is the hallux. It never seems to come down to the floor of its cage, if it can be avoided, though. I have once seen it fall off a branch when asleep ; it picks things up by clinging with the feet and lowering the body as well as the arms if necessary. I have once seen it drinking by lowering its head to the water. But it can walk in a clumsy way, if put on the ground. It sleeps as described by Blanford.

From the eagerness with which insects are taken—its enormous eyes almost seem to sparkle when one is produced and its whole attitude is one of intense interest and concentration, I imagine that these must be a considerable item in its diet when wild. If it manages to catch any number of longicorns and grasshoppers or crickets, it must do good. Its method—a slow approach and a final grab—would probably be fairly successful, especially with big insects. On occasions, it has caught big moths on the wing in its cage, but I am not sure what luck it would have in the open, except when wings are being dried after emergence from the pupa.

Felis bengalensis.—One killed on or near the Thandaung tea estate, the second in dense jungle. Burmese, *Kyaung Ba*, or *Kyaung Kwet.*

Felis affinis.—Shot round Toungoo, for the most part, usually found near villages, with wild domestic cats, with which it is said to inter-breed. Burmese, *Kyaung Bā.*

Viverra zibetha.—One or two seen at night, but they made off from the light too quickly to give a chance. One dried skin. Burmese, *Kyaung Myin.*

Viverricula malaccensis.—Burmese *Kyaung pazun-gaw* or *Kyaung Na Tha.* One killed contained 4 fœtuses.

Paradoxurus birmanicus.—One lives in a palm in my garden. Three more lived in the roof of my house in Katha. No. 1474 contained two fœtuses only ; they were mostly shot feeding on various fruit trees.

Herpestes birmanicus.—Burmese, *Mwe ba* ; obtained in the scrub jungle round Toungoo.

Herpestes urva.—Shot on a path in the hills round Thandaung. The stomach contained fragments of the shell of some crustacean.

Canis aureus.—Burmese *Kway-at* ; *Kye kway* is probably strictly a fox, and *Wunbalwe* a wolf, though my specimen got all three names given it by the pandits consulted. It was shot coming to a light, in an open Indaing reserve, in which half a dozen or so are said to live now. It is the only record of which I know so far from the dry zone, where they are fairly common in places.

Cuon sp.—I sent in a skin shot about 20 miles South of Toungoo but, I believe it was lost. (It was never sent to the S. Kensington Museum. *T. B. F.*) No. 1089. The beast is said to have gone for the man who shot it. The skin was in very bad condition and had no skull.

Charronia flavigula.—Burmese *Thit-tet-she.* The specimen sent was one killed by dogs out of 4 or 5. I have seen another (a dark specimen) in the jungle on the West bank and a second (a light one) nearly on the top of Thandaunggyi.

Melogale personata.—Burmese *Kyaunga U-Gyi.* Caught in a garden.

Tupaia belangeri.—Burmese "*Swe*' 3 prs. abd. mammæ, and not as stated by Blanford 2 prs. only. Near a certain rest house one of these little beasts turned up every day, at the same hour (about 3.45 p.m.) and ran along the fence, getting on to it, and getting off it at the same points. One day I saw it come off the fence into the compound and eat something—apparently the seeds of some weeds. They are usually found in scrub jungle, or heaps of rubbish.

The pigmy shrews.—Usually caught when driven out of their burrows by floods. Two were found, fighting fiercely at the mouth of a tiny hole. They were brought back in a vaseline bottle just being able to run round the bottom in ' tandem ' without getting in each other's way.

Bats.—Burmese (generic), *Linok.*, *Pteropus* sp. *Lin Swe.* I have given notes on the labels as to where each was found. My collector is not very good on them, and I have little doubt that there are a good many more than I have found. The one exception is the *Megaderma.* Three of these were found flying round a jungle bungalow. I can confirm Mr. Frith's remarks quoted in Blanford, in every respect. The beasts used to drop frogs' hind quarters, etc., on my mosquito curtain. On one occasion a mouse's head was picked up. Remains of small fish were found, though how bats catch a fish, I am not prepared to guess. Frogs and mice would seem to present sufficient difficulties, even allowing the beast to have the powers of a hawk or owl. They are not very big.

Petaurista (Large Flying Squirrel)—Burmese *Shu Byan.* Shot feeding at night. Feeds on shoots as well as fruits. Very destructive to tree seeds of all sorts, especially Pyinkado (*Xylia dolabriformis*). I have never seen nests down here such as I have found in the Upper Chindwin.

Small Flying Squirrel :—A very inadequate lot, I am afraid. Burmese *Shing Shu.* A wood-cutter told me he had seen about three dozen of these come out of one hollow tree which he felled.

Squirrels. —Burmese (generic), *Shing.*

Ratufa.—Burmese *Shing-apaw* (not *apan,* Blanford) Upper Burma), *Lin-thet* (Lower Burma). I can find nothing governing the colour variations from brown to black, having shot two specimens almost extreme in both directions from one tree at the same time. A squirrel of high forest. Has a habit of lying asleep along a branch, and the only thing to be spotted is the tail hanging down.

Callosciurus ferrugineus—Burmese *Shing-apaw*, or *Shing Nipaw.* Found on both banks but I have not found it on the East bank, farther up than 25 miles North of Toungoo.

A squirrel of high forest and tree tops.

Callosciurus rufigenis. —Only found round Thandaung, say above 3,000 ft. (East bank).

Tomeutes phayrei.—Burmese *Shing apaw.* Only found upon the East bank. Some seem to have *grey* feet. Lives in high forest, where I have seen both it and *C. ferrugineus* diligently eating teak seed off the tree.

Tomeutes pygerythrus :—Common in the scrub round all villages and in all clearings and gardens, rare in heavy jungle.

A friendly little animal. I have two in my garden, who run along the same branches, of the same rain-tree, in exactly the same way, and at exactly the same time, every day, just outside my bed-room window. They are even more punctual than my boy in waking me by their shrill squeaks. They eat all my custard apples and I regret to say, were once guilty of eating the eggs of a magpie robin which built in the rafters of my verandah. They often come down to the ground and run across my lawn from hedge to a palm. I have also often seen them on the ground in the jungle. They run very quickly for their size, on the ground, but on trees, they have a funny, jerky motion, almost hopping in fits and starts, both when spread-eagled on the bole and running along a branch. They jerk their tails in time with their movements, in a most amusing way.

Tamiops macclellandi.—Burmese *Shing*, *Gya*. A squirrel of medium and high forest, never found on the ground. It has a shrill high squeak like a bat's which some people cannot hear. It is very shy, and very quick and so very difficult to get, as it lies flat on a branch, and is completely lost from below.

Menetes berdmorei.—Only found on the West bank and very scarce at that, though it may be mistaken for *pygerythrus*, which it closely resembles in its habits. Blyth is incorrect in doubting that it ever ascends trees. I have shot one out of a tree 40 ft. high. But I think it prefers the ground and scrub, also heaps of firewood and branches. Always found round clearings for cultivation, but usually in rather jungly clearing; i.e., not close to the railway with a long stretch of paddy fields between it and the nearest real jungle.

Bandicoots, Rats & Mice.—Burmese (generic, *Kywet*, Bandicoots, *Mye Kywet*). I am afraid I do not know enough about them to give any details other than those on the labels. Some were caught in a nursery feeding on Kalaw seed (*Taraktogenos Kurzu*) and I should be glad to know their names Nos. 879–887 and 900–903.

(See corrected list of spirit specimens appended. *T. B. F.*).

They do much damage, and the first step in stopping it seems to be identification.

Bamboo Rats.—Burmese; *Pwe* I have never heard Blanford's '*Khai*' I found one lying dead on a jungle path—no apparent reason. Common.

Lepus peguensis.—Burmese *Yon*. It is to be remembered that at the time Blanford wrote what is practically now Lower Burmah, was then called Pegu. Most of my specimens were shot with the aid of 'Mok So Kwaya' or hunting dogs; the dogs got to some of the specimens before they could be collected, but they lost some behind bunds or furrows. I saw one which I had been after for some days, put up out of a patch of weeds by a crowd going home after a football match. It took refuge in a drain, but was promptly got out with a bamboo and taken home to or for dinner. I have often put them up in scrub jungle round villages; they make a 'form' under a tuft of grass or small shrub and sit very tight; when put up in scrub jungle, they jink so much as to be almost unshootable. I have never heard of them using holes, but they may do so. All I have put up have been from forms; they are undoubtedly filthy feeders, and should not be eaten if shot near any human habitation.

They are quite easy to get with dogs in the rains, when their movements are circumscribed by floods. I have heard on good authority of 5 being seen together in a jungle bungalow compound on a moonlight night.

Muntiacus.—Burmese *Gyi*. Very common. I shot one with its stomach full of 'gwe' (*Spondias mangifera*, Willd.) fruit. The fruit had been eaten whole.

Sambhur.—One skin. Burmese *Sat.* Quite common, judging from tracks but I have never seen one here. They chew the bark off young Yemané (*Gmelina arborea*) trees to such an extent that they kill whole plantations. They also break and eat the leading shoots of smaller trees. Once a plantation is found it is killed out.

Hyelaphus porcinus.—Burmese *Daye.* All those shot were obtained when they were cut off on temporary islands made by floods. The method leaves much to be desired from a sporting point of view but the specimens were wanted. In any case—a plea of very doubtful validity—they would have been killed and eaten when cut off in this way. I am sure the animal mortality is very heavy from this cause; floods come up every year, and I think every beast cut off in this way ends up in someone's cooking pot. They are gramivorous and require long periods for feeding, given time, they can be killed by starvation and exhaustion consequent on continuous hunting and harrying as every local man knows.

Sus cristatus.—Burmese *Wet.* (*Taw Wet* = jungle pig). Very common, but also very wily. Tracks all over the place, but I have only seen one, and he got away before I could get a gun. My man has spent a good deal of time trying to get specimens and the only result is the juvenile skin sent.

I am afraid the above are rather scratch notes. I have put in full details on my labels and have tried not to repeat them here.

J. M. D. MACKENZIE.
Deputy Conservator of Forests,
North Toungoo Division.

MACACA MULATTA, Zimm.

The Rhesus

(Synonymy in No. 16).

Toungoo, ♂ 2, ♀ 1; 13 miles E. of Toungoo, ♂ 1, ♀ 1.

PITHECUS PYRRHUS PHAYREI, Blyth.

Phayre's Langur

(Synonymy :—See note below)

30 miles N. of Toungoo, ♂ 3; 30 miles N. W. of Toungoo, ♀ 2.
35 miles N. W. of Toungoo, ♀ 1.

No specimen of what was known as *P. obscurus barbei* which closely resembles *P. p. phayrei*, was obtained during the Survey, although it may exist in some of the areas worked over. Mr. Pocock has recently reviewed the Indian Langurs, and his classification is now adopted; his reasons for removing this monkey from the *obscurus* group will be found in his paper published in the Society's Journal (Vol. xxxii).

PTEROPUS GIGANTEUS, Bruenn.

The Indian Flying Fox

(Synonymy in No. 2)

Toungoo, ♂ 2, ♀ 5.

CYNOPTERUS SPHINX SPINX, Vahl.

The Southern Short-nosed Fruit Bat

(Synonymy in No. 6.)

Toungoo, ♂ 3, ♀ 3 ; 40 miles N. of Toungoo, ♂ 1.

In the first collection from Toungoo the single specimen of *Cynopterus* included was reported as *C. brachyotis angulatus*, making it apparent that both species (if indeed there are two species) exist in this locality ; the present specimens have a somewhat longer fore-arm and the skulls are of a slightly heavier type, broader more especially in the brain case ; otherwise there is no very marked difference in the two species.

CYNOPTERUS BRACHYOTIS ANGULATUS, Mill.

The Malay Short-nosed Fruit Bat

(Synonymy in No. 17)

Toungoo, ♂ 1, ♀ 2 ; 16 miles W. of Toungoo, ♂ 3, ♀ 3.

These specimens show the slight differences from *C. sp. spinx* noted above and are classed accordingly. It may however be added that Mr. J. H. Lindsay, I.C.S. (retired) has recently studied these bats and could not find any definite grounds for separating the one from the other.

RHINOLOPHUS AFFINIS TENER, K. And.

The Pegu Horse-shoe Bat

1905. *Rhinolophus affinis tener.* K. Andersen, Pros. Zool. Soc. vol. 2, p. 75.

Toungoo, ♂ 1 ; 40 miles N. E. of Toungoo, ♀ 1.

K. Andersen separated this bat from *R. affinis* on a spirit specimen obtained from Pegu, though recognizing it as a species closely allied to *R. rouxi*. No doubt the bat is comparatively rare except perhaps in this part of Burmah.

HIPPOSIDEROS BICOLOR, Temm.

The Bicoloured Leaf-nosed Bat

1835. *Rhinolophus bicolor*, Temminck, Mon. Mam. ii. p. 18.
1838. *Hipposiderus fulvus*, Gray, Mag. Zool. Bot. ii, p 492.
1889. *Hipposiderus bicolor*, Blanford's Mamm. No. 166.

Thangdaung, 20 miles N. E. of Toungoo, ♀ 1.

LYRODERMA LYRA, Geoff.

The Indian Vampire Bat

(Synonymy in No. 1)

36 miles N. of Toungoo, ♀ 1.

SCOTOPHILUS CASTANEUS, Horsf.

The Chesnut Scotophil

(Synonymy in No. 17)

Toungoo, ♂ 7, ♀ 8, 3 unsexed ; 40 miles N. E. of Toungoo, ♂ 6, ♀ 6.

Ten specimens of this bat obtained in Tenasserim by Mr. G. C. Shortridge were shown in Report No. 17, as *S. wroughtoni*, this error being subsequently corrected by Mr. Wroughton. These two bats are not readily distinguishable, but *S. castaneus* is slightly the larger of the two, the skull being of a distinctly heavier type and somewhat longer. As in the case of the *Cynopterus* these two species appear to meet in Burmah somewhere about the latitude of Toungoo.

TAPHOZOUS LONGIMANUS, Hardw.

The Long-armed Sheath-tailed Bat

(Synonymy in No. 6)

30 miles N. of Toungoo, ♂ 1, ♀ 1; 16 miles N. of Toungoo, ♂ 3, ♀ 4.

The range of this bat is a very wide one, covering the greater part of India and Burmah. Blanford states that it is found in Ceylon, but no specimens were procured from the Island by the Survey, nor again were any received from East of Palanpur or from N. W. Punjab. (*Re* occurrence of this species in Ceylon and change of colouring from young to adult see note by W. W. A. Phillips, vol. xxxii, p. 371 of the Journal. EDS.)

TUPAIA BELANGERI, Wagn.

The Burmese Tree Shrew

(Synonymy in No. 17.)

Toungoo, ♂ 2, ♀ 1 ; 30 miles N. of Toungoo, ♀ 1.
6 miles E. of Toungoo, ♂ 3, ♀ 2 ; 30 miles N. W. of Toungoo, ♂ 1.
36 miles N. E. of Toungoo, ♂ 2 ; 10 miles N. of Toungoo, ♂ 2, ♀ 1.
30 miles N. W. of Toungoo, ♂ 6 ; 35 miles N. of Toungoo, ♂ 1 ; 40 miles N. of Toungoo, ♂ 1.

SUNCUS FULIGINOSUS, H. Lindsay.

The Common Pegu Shrew

Toungoo, ♀ 7 ; 40 miles N. E. of Toungoo, ♂ 1.

Beyond noting that the older generic name 'SUNCUS' has been reverted to in the place of 'PACHYURA', no remarks are called for here, as details regarding this and other Indian Shrews will be found in Mrs. Lindsay's paper on the subject published in the Society's Journal, vol.xxxiii, p. 326.

CROCIDURA KINGIANA, And.

King's Shrew

6 miles E. of Toungoo, ♀ 1.

FELIS AFFINIS, Gray.

The Jungle Cat

Toungoo, ♂ 2, ♀ 3 ; 6 miles E. of Toungoo, ♂ 1.

FELIS BENGALENSIS, Kerr.

The Leopard Cat

(Synonymy—See remark in No. 2)

Thandaung, 20 miles N. E. of Toungoo, ♂ 1 ; 40 miles N. W. of Toungoo, ♂ 1.

FELIS DOMESTICUS

The Tame Cat

Toungoo, ♂ 3.

One yellowish and two greyish coloured, varieties that may be found almost anywhere.

FELIS MARMORATA, Martin.

1836. *Felis marmorata*, Martin, P. Z. S. p. 109.
1846. *Felis charltoni*, Gray, A. M. N. H. xviii, p. ii.
1849. *Felis marmorata*, Blanford's Mamm. No. 33.

Two native dried skins, no other specimens obtained by the Survey.

FELIS PARDUS, L.

The Panther

Skin from Toungoo District but no details given.

VIVERICCULA MALACCENSIS, Gmel.

The Small Indian Civet

(Synonymy in No. 3.)

1 unsexed. No details.

PARADOXURUS BIRMANICUS, Wrought.

The Burmese Palm Civet

(Synonymy in No. 16.)

6 miles E. of Toungoo, ♂ 4, ♀ 1 ; 30 miles N. W. of Toungoo, 2 unsexed.
40 miles N. W. of Toungoo, ♂ 1.

HERPESTES BIRMANICUS, Thos.

The Small Burmese Mongoose

Toungoo, ♂ 4, ♀ 4 ; 40 miles N. of Toungoo, ♂ 1, 1 unsexed.

CANIS AUREUS, L.

The Jackal

6 miles E. of Toungoo, ♂ 1.

Jackals from Mt. Popa and Chindwin were reported as *C. indicus* but possibly *indicus* as a specific name will be dropped when Blanford's Mammalia is revised, since it seems to be generally recognized that all the Jackals are of one species.

CHARRONIA FLAVIGULA, Bodd.

The Northern Indian Marten

(Synonymy in No. 15.)

35 miles N. W. of Toungoo, 1 unsexed.

HELARCTOS MALAYANUS, Raffles.

The Malay Bear

(Synonymy in No. 14.)

40 miles N. E. of Toungoo, 1 unsexed.

PETAURISTA CINERACEUS, Blyth.

The Tenasserim Brown Flying Squirrel

(Synonymy in No. 29.)

20 miles N. of Toungoo, ♂ 3, ♀ 2 ; 30 miles N. of Toungoo, ♂ 6 ; 36 miles N. W. of Toungoo, ♀ 1. 13 miles E. of Toungoo, ♀ 1 ; 6 miles E. of Toungoo, ♀ 1 ; 30 miles N. W. of Toungoo, ♂ 2 ; 40 miles N. W. of Toungoo, ♂ 1.

BELOMYS TRICHOTIS, Thos.

The Black-eared Belomys

(Synonymy in No. 20.)

13 miles E. of Toungoo, ♀ 1.

The English name given here was proposed by Mr. Wroughton to distinguish *B. trichotis* from *B. pearsoni* which has red ears.

HYLOPETES PHAYREI PROBUS, Thos.

Blyth's Flying Squirrel

(Synonymy in No. 16.)

5 miles . E. of Toungoo, 1 unsexed ; Toungoo, ♂ 1.
20 miles N. of Toungoo, ♂ 1, ♀ 1.

RATUFA PHÆOPEPLA MARANA, Thos & Wrought.

The Central Burmese Giant Squirrel

(Synonymy in No. 16.)

6 miles E. of Toungoo, ♀ 2 ; 10 miles N. of Toungoo, ♂ 1.
20 miles N. of Toungoo, ♂ 2 ; 30 miles N. of Toungoo, ♂ 1.
36 miles N. of Toungoo, ♂ 3, ♀ 1 ; 40 miles N. of Toungoo, ♂ 1.
30 miles N. W. of Toungoo, ♂ 3.

A specimen of this Squirrel was incorrectly reported in No. 46. as *R. gigantea*. The English name was altered in the Pegu Report. No. 29,

DREMOMYS RUFIGENIS ADAMSONI, Thos.

The Red-cheeked Squirrel

(Synonymy in No. 14.)

Thandaung, 4,500, feet, 20 miles N. E. of Toungoo, ♀ 2.

CALLOSCIURUS FERRUGINEUS, F. Cuv.

The Burmese Bay Squirrel

(Synonymy in No. 16.)

30 miles N. of Toungoo, ♂ 5, ♀ 2 ; 36 miles N. of Toungoo, ♂ 6, ♀ 5.
30 miles N. W. of Toungoo, ♂ 2, ♀ 4 ; 40 miles N. W. of Toungoo, ♂ 2.
30 miles N. E. of Toungoo, ♀ 1.

TOMEUTES PHAYREI PHAYREI, Blyth.

Phayre's Squirrel

(Synonymy in No. 14.)

Toungoo, ♂ 2, ♀ 2 ; 5 miles E. of Toungoo, ♂ 2, ♀ 3.
6 miles E. of Toungoo, ♂ 3, ♀ 1 ; 16 miles N. of Toungoo, ♂ 1 ; 20 miles E. of Toungoo, ♂ 1.
10 miles N. of Toungoo, ♂ 1, ♀ 2 ; 40 miles N. E. of Toungoo, ♂ 1.

TOMEUTES PYGERYTHRUS, Geoff.

The Irrawady Squirrel

(Synonymy in No. 29.)

16 miles N. of Toungoo, ♂ 5, ♀ 2 ; 20 miles N. of Toungoo, ♂ 1, ♀ 1.
30 miles N. W. of Toungoo, ♂ 3, ♀ 3 ; 40 miles N. of Toungoo, ♂ 3, ♀ 6.
Toungoo, ♂ 3, ♀ 3.

MENETES BERDMOREI, Blyth.

Berdmore's Squirrel

(Synonymy in No. 16.)

35 miles N. of Toungoo, unsexed 1 ; 36 miles N. of Toungoo, ♂ 2

MENETES BERDMOREI DECORATUS, Thos.

Berdmore's Squirrel

(Synonymy in No. 16.)

10 miles N. of Toungoo, ♂ 1 ; 6 miles N. of Toungoo, ♀ 1 ; 30 miles N. W. of Toungoo, ♀ 1.

TAMIOPS MACCLELLANDI BARBEI, Blyth.

The Striped Burmese Squirrel

(Synonymy in No. 14.)

6 miles E. of Toungoo, ♂ 4, ♀ 2 ; 8 miles W. of Toungoo, ♀ 1 ; 13 miles E. of Toungoo, ♂ 1.
30 miles N. W. of Toungoo, ♂ 1 ; 35 miles N. of Toungoo, ♂ 1.

BANDICOTA NEMORIVAGA, Hodgs.

The Smaller Bandicoot Rat

1836. *Mus* (*Rattus*) *nemorivaga*, Hodgson, J.A.S.B. , p. 234.
1878. (*Nesokia*) *elliotanus*, Anderson, J.A.S.B. xlvii, p. 231.
1889. *Nesokia bandicota*, Blanford's Mammalia, No. 296.
Toungoo, ♀ 6.
This bandicoot was incorrectly recorded as *B. elliotana* in Report No. 19.

GUNOMYS VARIUS, Thos.

The Malay Mole-Rat

(Synonymy in No. 17.)

Toungoo, ♂ 7, ♀ 5; 35 miles N. of Toungoo, ♂ 1.

Among these specimens were skins of 9 young ones which were originally identified as *B. savilei*, but Mr. Thomas has recently been working on this species and has now definitely classed all the specimens in Mr. Mackenzie's last two collections as *Gunomys varius*.

RATTUS CONCOLOR, Blyth

The Little Burmese Rat

(Synonymy in No. 17)

Toungoo, ♂ 4, ♀ 4; 6 miles E. of Toungoo, ♂ 1; 30 miles N of Toungoo, ♂ 1.

RATTUS RATTUS KHYENSIS, Hint

The Shan Tree Rat

1918. *Rattus rattus khyensis*, Hinton, J.B.N.H. Soc. vol. xxv, p. 60.
Toungoo ♂ 3 ♀ 6; 36 miles N. of Toungoo, ♂ 5, ♀ 2, unsexed 1.
40 miles N. W. of Toungoo, ♂ 1, ♀ 2.

The white bellied rat from this district is undoubtedly similar to that found in the Shan States, the type locality of *khyensis*.

RATTUS RATTUS RUFESCENS, Gray.

The Common Indian Rat

(Synonymy in No. 1)

Toungoo, ♀ 2, ♂ 1.

MUS HOMOURUS, Hodgs.

The Himalayan House Mouse

(Synonymy in No. 15.)

Toungoo, ♂ 16, ♀ 12, unsexed 1; 36 miles N. of Toungoo, ♀ 4.
40 miles N. of Toungoo, ♂ 1, ♀ 6, unsexed 2.

CANNOMYS PATER, Thos.

The Bay Bamboo Rat

(Synonymy in No. 14.)

11 miles N. of Toungoo, ♀ 1; 10 miles N. of Toungoo, ♂ 3, ♀ 8.

LEPUS PEGUENSIS, Blyth.

The Pegu Hare

(Synonymy in No. 16)

Toungoo, ♂ 9, ♀ 4; 30 miles N. of Toungoo, ♂ 1.
40 miles N. of Toungoo, ♂ 4, ♀ 2; 40 miles N.W. of Toungoo, ♂ 1.

MUNTIACUS GRANDICORNIS, Lydd.

The Tenasserim Rib-faced Deer

(Synonymy in No. 2)

Toungoo, ♀ 1; 11 miles N. of Toungoo, ♀ 1; 30 miles N.W. of Toungoo, ♂ 1.
35 miles N.W. of Toungoo, ♀ 2; 36 miles N. of Toungoo, ♀ 1;
40 miles N. of Toungoo, ♂ 1.

The Muntjac is found throughout India, Ceylon, Burmah, Malay States, etc. and showing slight differences in size, color and horns has consequently been separated into a number of species by various zoologists, but it would appear to be very doubtful whether all these species are worthy of recognition. Quite possibly after further study of these small deer it may be decided that they are all of one species, varying slightly according to local conditions, and therefore entitled only to subspecific or racial names.

CERVUS ELDI, Guthrie.

The Pegu Thamin

1842. *Cervus eldi*, Guthrie, Calc. Jour. N. H. ii, p. 417.
1888. *Cervus eldi*, Blanford's Mammalia No. 366, p. 541
Toungoo, ♀ 1.

HYELAPHUS PORCINUS, Zimm.

The Hog Deer

(Synonymy in No. 20)

Toungoo, ♂ 2.

SUS CRISTATUS, Wagner.

The Indian Wild Boar

(Synonymy in No. 5)

10 miles N. of Toungoo, ♂ 1. (juv.)
An interesting specimen, illustrating the striped appearance of the very young animal.

SPIRIT SPECIMENS

List (duly amended) attached to third Collection.

879.	*Rattus manipulus*	22- 9-1926	Toungoo.
880.	,, *concolor*	28-10-1926	,,
881.	,, ,,	,,	,,
882.	,, ,,	,,	,,
883.	,, ,,	31-10-1926	,,
884.	,, ,,	7-11 1926	13 miles E. of Toungoo.
885.	,, ,,	3-11-1926	,,
886.	,, ,,	8-11-1926	,,
887.	,, *r khyensis* (melanistic)	,,	,,
893.	,, ,,	14-12-1926	Toungoo.
894.	*Cynopterus sp. sphinx*		,,
895.	,, ,,		30 miles E. of Toungoo.
896.	,, ,,		Toungoo.
897.	,, ,,		30 miles N. of Toungoo.
900.	*Rattus concolor*	11-11-1926	13 miles E. of Toungoo.
901.	,, ,,	19-12-1926	,,
902.	,, *manipulus*	22- 9-1926	,,
903.	*Chiropodomys gliroides*	2-10-1926	,,
926.	*Cynopterus sp. sphinx*	10- 1-1927	Toungoo.
927.	*Hipposideros bicolor*	,,	,,
966.	*Scotophilus castaneus*		,,
1027.	*Tomeutes pygerythrus*	(fœtus) (ex 1006)	
1045.	*Cynopterus sp. sphinx*	(fœtus ex 1044 name doubtful)	
1047.	,, ,,	(ex 1046 ,, ,,)	
1049.	,, ,,	(ex 1048 ,, ,,)	
1055.	*Taphozous longimanus*	(fœtus ex 1053)	
1064.	*Tupaia b. belangeri*	(fœtus ex 1063)	
1127.	,, ,,	(fœtus ex 1125)	
1087.	*Felis pardus*	(fœtus ex 1087)	
1130	*Scotophilus castaneus*		Toungoo.
1132.	*Rattus concolor*	13- 5-1922	36 miles N. of Toungoo.
1133.	*Lepus peguensis*	19- 5-1927	Toungoo.
1145.	*Tomeutes pygerythrus*	(fœtus ex 1144)	
1174.	*Mus homourus*	1- 6-1927	Toungoo.
1175.	*Mus homourus* (juv.)	1- 6-1927	,,
1184.	*Suncus nudipes*	4- 6-1927	,,

1201.	*Mus homourus* (juv.)	12- 6-1927	Toungoo.
1202.	,, ,,	,,	,,
1203.	,, ,,	,,	,,
1204.	,, ,,	,,	,,
1231.	*Scotophilus castaneus*	20- 6-1927	,,
1232.	,, ,,	,,	,,
1236.	,, ,,	21- 6-1927	,,
1265.	*Suncus nudipes*		,,
1292.	*Cynopterus sp. sphinx*	(fœtus ex 1268)	(name doubtful)
1294.	*Cervus eldi*	(fœtus ex 1293)	
1309.	*Mus homourus*	(fœtus ex 1258)	
1311.	*Rattus concolor*	22- 8-1927	36 miles N. of Toungoo.
1353.	*Cynopterus sp. sphinx*		Toungoo.

SOUND PRODUCTION BY A LARVA OF CYBISTER (*DYTISCIDÆ*)

BY

DURGADAS MUKERJI,

Lecturer in Zoology, University College of Science, Calcutta

In July last, I collected a live larva of a beetle belonging to the Dytiscidæ family, from a small ditch of water in the neighbourhood of Halisahar in the district of 24-Perganas, Bengal, and had an opportunity of observing the interesting phenomenon of sound production by the emission of tracheal air through its meso-thoracic spiracles.

The larva was aquatic in habit and measured nearly 55 mm. in length. It seemed to me that the specimen was at the final stage of its larval life, judging from its rather long body.

The larva belongs to the genus *Cybister* and appears to be that of *Cybister confusus* Sharp, occurring in Bengal. It closely resembles *Dytiscus* larva in the possession of a flat head, curved and pointed jaws, pigmented eyes and last two abdominal segments provided with hairs on their lateral edges. It is easily distinguished from the latter by the absence of a pair of styli at its posterior end. The *Dytiscus* larva hangs with its head downward keeping the tip of the abdomen above the surface of water and the styli help it in hanging. The tip of the abdomen contains a pair of spiracles. The *Dytiscus* larva takes up air by means of these spiracles. Portier (1911)[1] mentions that *Cybister* larvæ, in view of the absence of styli at their posterior end, cannot remain suspended from the surface of water or live long in deep water. The larva, as in the case of *Dytiscus* larvæ, possesses ten pairs of spiracles. Of these, two pairs belong to meso-and meta-thorax and the rest to the abdomen, each abdominal segment carrying one pair. The thoracic spiracles lie on the ventral side while the abdominal pairs except the last, are found on the lateral margins of the body. The last pair of abdominal spiracles is situated at the tip of the abdomen and being pushed up above the surface of water enabled it to have direct access to the atmosphere for respiration. All the other spiracles, due to the habit of larva in keeping itself under water, have little or no chance of coming in direct contact with air, and are non-functional so far as respiration is concerned and are regarded as closed. It must, however, be noted that the meso-thoracic spiracles are of considerable importance in the present case as they alone are concerned in the production of sound and clearly open to the exterior.

The larva was quite active during its captivity in the laboratory. It was placed in a petri dish half filled with water just enough to cover the body of the larva. The larva lived in this state for four days without taking any food and was afterwards killed. It obtained air for respiration by lifting the tip of the abdomen above the surface of water while its body rested upon its legs.

On the day following the capture I took up the live larva in my hand and was examining it under a hand lens. The larva apparently did not like the situation and attempted to wriggle out of my fingers. The consequence was that I had to tighten my grip over it and the larva responded by emitting a strange squeaking sound which indeed took me by surprise. To enquire as to the exact cause of the sound the larva was put back in water and I waited for an hour in vain to see if it would produce the same sound again. Then I teased it with a blunt mounted needle. The larva got irritated, jumped suddenly up by throwing its body into a curve and emitted at the same time the peculiar sound. The larva, of course, was forced to repeat the sound several times that day and there was no doubt about the production of sound by it. I observed that it could more easily be induced to make the sound if its abdomen was pressed hard or squeezed. It was also seen that the larva would produce the sound on being sufficiently disturbed without being hurt. The sound was given out on irritation whether the larva was in or out of water. It did not, however, make any noise when left undisturbed.

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[1] Portier (1911), Recherches physiologiques sur les insectes aquatiques *Archiv. Zool. Esp.*, Ser. 5, vol. viii.

It is interesting to note that each time the sound was emitted the body was thrown into muscular jerks and the larva after emitting the sound at short intervals appeared fatigued.

The sound was of short duration but intense. Its intensity was such that my colleague, Mr. J. L. Bhaduri, who was working at the next bench a few feet away, came to mine attracted by the sound, and also began teasing the creature. The larva, however, had now its revenge. It drove its powerful pointed jaws right into his finger and drew blood, before Mr. Bhaduri could satisfy his curiosity. It was noticed further that a clear fluid of greenish brown colour ran out of the mouth of the larva when its jaws pierced Mr. Bhaduri's finger.

The object of making the sound probably is to frighten its enemies as it was produced only when the creature was in danger.

The larva was then examined by me for the mechanism of its sound production. A careful search under the binocular microscope did not show the existence of a stridulatory organ. As the production of sound other than by means of friction could be possible by the expulsion of a current of air from the trachea, the spiracles of the larva were subjected to careful observation by placing it under water and irritating it to emit sound. When the larva was placed under water on its dorsal surface and was forced to give out the sound, a small stream of air briskly bubbled out through water from the right spiracle of the mesothorax. The quick escape of air from the same aperture was also observed when the larva produced the sound on being poked without being hurt. But no bubbles of air could be seen escaping through thoracic spiracles during ordinary respiratory activity. Since the issuing of air through the right meso-thoracic spiracle was concomittant with the emission of sound there could be no doubt that sound was produced by the forceful expulsion of tracheal air through the spiracle. As sound in the present instance was caused by emission of air, the larva in this respect might be said to have a voice. Spiracles were further observed under binocular microscope after the larva was killed and put under water. Bubbles of air were found around the right as well as left spiracles of the meso-thorax adhering to their surfaces and glistening through water. On pressing the body of the larva for the first time after its death, bubbles of air were liberated from the meso-thoracic spiracles. The presence of air bubbles on the external surface of both right and left spiracles and disengagement of air from them indicate the possibility of ejection of air through both spiracles and not through a single spiracle as the actual observation of the live specimen disclosed. An explanation of why the air was seen to pass out of the right spiracle only might be found in the fact that during the observation the larva was forced to lie on its dorsal surface which limited the movement of its body in certain directions and thus the tracheal air was forced to pass out through a particular spiracular aperture of the meso-thorax.

As to the cause which leads to the forcing out of the tracheal air through the thoracic spiracles resulting in the emission of the sound, it may be mentioned again that just before or at the time of emission of the sound, the body of the larva was either thrown into powerful musclar jerks or its posterior region of the abdomen was artificially pressed. It is evident from this that the expulsion of air from the trachea was brought about by the muscular contraction of the body especially of the abdominal region. It may also be noted that the main trunks of tracheæ of *Cybister* larvæ as shown by Portier are peculiar in presenting a number of constrictions along their lengths.

It may be further mentioned that W. Alt (1912)[1] from his study of the structure and histology of respiratory system including spiracles of the *Dytiscus* larva suggests the possibility of sound production in the larva by the escape of air from the trachea through the thoracic spiracles which he shows as open.

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[1] W. Alt (1912), Uber das Respiration system von *Dytiscus marginalis*, *Zeit. Wiss. Zool.*, xlix.

Miall (1912)[1], however, states these spiracles as closed. The tracheal air therefore when forced out possibly sets into vibration the membranes and hair lining the tracheæ near their spiracular openings, resulting in the production of sound.

It is also interesting to note that Wesenburg-Lund (1911–12)[2] reports the buzzing noise emitted by the winged forms of *Dytiscus* beetles. He points out that such buzzing noise is distinct from the note produced by the stridulatory organ when present. The buzzing sound, in his opinion, is caused by the emptying out of air from the tracheæ through the first pair of spiracles. The first pair of spiracles (prothoracic) of winged forms of the Dytiscidæ may be considered, in view of the shifting forward of spiracles during the developmental history of insects in general, to correspond with the first pair of spiracles (mesothoracic in position) of their larvæ. Thus there appears to be certain similarity in the physiology of production of sound among the larval and adult stages of the beetles of the Dytiscidæ family.

Further, the emission of air from the meso-thoracic spiracles of the larva coming as it does under the Dytiscidæ family has an important bearing on the disputed question of open or closed nature of spiracles of larvæ of the Dytiscidæ. The passage of air through the meso-thoracic spiracles clearly shows that the spiracles of the meso-thorax of this particular larva at this stage of its life are open to the exterior. The entry of water into tracheæ through the open spiracles is prevented from mainly by the action of surface tension as pointed out by Alt as well as by Wesenburg-Lund.

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[1] Miall (1912), Aquatic Insects.

[2] Wesenburg-Lund (1911–12), Biologische studien uber Dytisciden, *Biol. Suppl.* vol. v, *Series* v, *zur Inter. Nat. Rev. ges. Hydro. Bio, Hydrog.*, v.

A REED-BED IN THE DAL LAKE, KASHMIR

BY

CAPTAIN R. S. P. BATES, M.B.O.U.

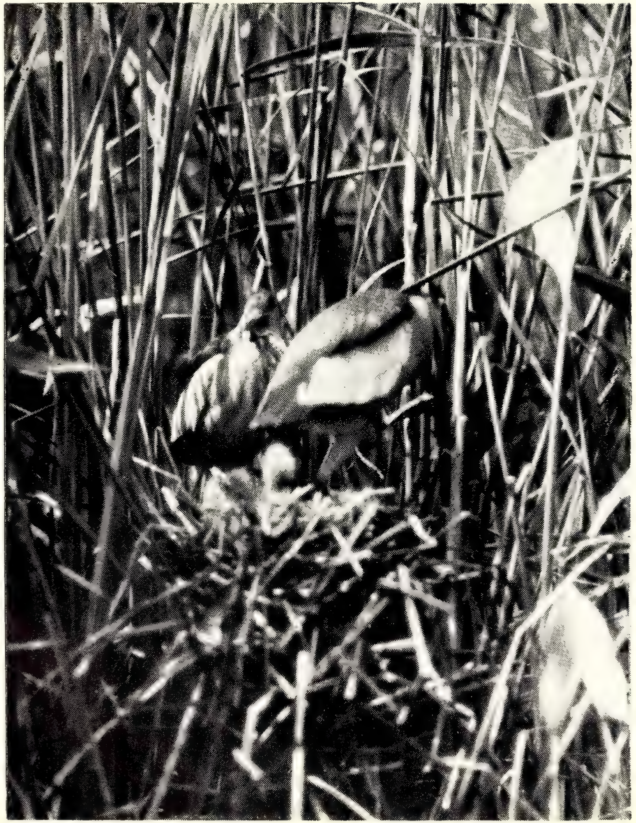
(*With six plates*)

After a lapse of seven whole years I found myself on the 18th of June contemplating once more the beds of swaying reeds and bulrushes which flank the canal between the Dal Gate and Gagribal Point. This thoroughfare to the Dal Lakes is thronged throughout the day and obviously the greater part of the night with scurrying shikaras, the crews of which invariably hate the idea of being passed by any other craft, and with shouts of exhortation and much splashing of the unfortunate occupants institute a race on every possible occasion. Lumbering country boats, the families inhabiting which are continually engaged in wordy warfare with one another, glide slowly up and down, and house-boats of all sizes and descriptions occupy every backwater and line almost every yard of the edges of the canal itself. Even so my recollections of the last time I waded amongst these self-same quivering green masses left no doubt in my mind that the fortnight I had allowed myself for attempting to photograph their bird-life would be fully occupied and such was the case.

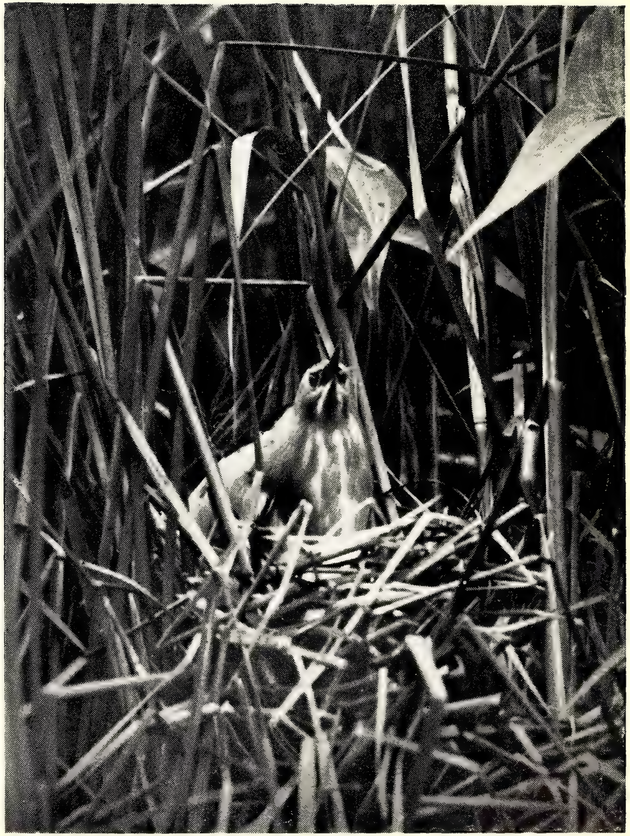
Our house-boat was ensconced in a backwater on the east side of the canal about midway to the point, a large patch of tall green rushes on either side of it rustling and sighing at every puff of wind and of course I first turned my attention to these to explore their somewhat steamy interiors. Mosquitoes did not prove to be such a pest as I had feared, but by the afternoons the air within the beds was most humid and unpleasantly hot with the result that to begin with I confined my explorations and photography within them to before and after breakfast. The former habit I soon gave up as I found the quality of the light up to about 9 o'clock was most doubtful and consequently results rather poor.

For the first two days I felt distinctly disappointed. Birds seemed amazingly scarce. Even the chattering Reed-Warblers appeared to me to be in lesser numbers than formerly though their strident voices were, as ever, a distinct feature of that beautiful stretch of water and weed. The Little Bittern I hardly saw, one flopping lazily across the prow of the boat from one side of our backwater to the cover of the reeds on the other. The Dabchick I did not remark and the Indian Moorhen only made its presence felt by upraising its voice once or twice from the depths of the reeds. The Indian Whiskered Tern never once appeared, and this bird and the Dabchick I am of opinion are definitely scarcer than formerly in the Dal Lake

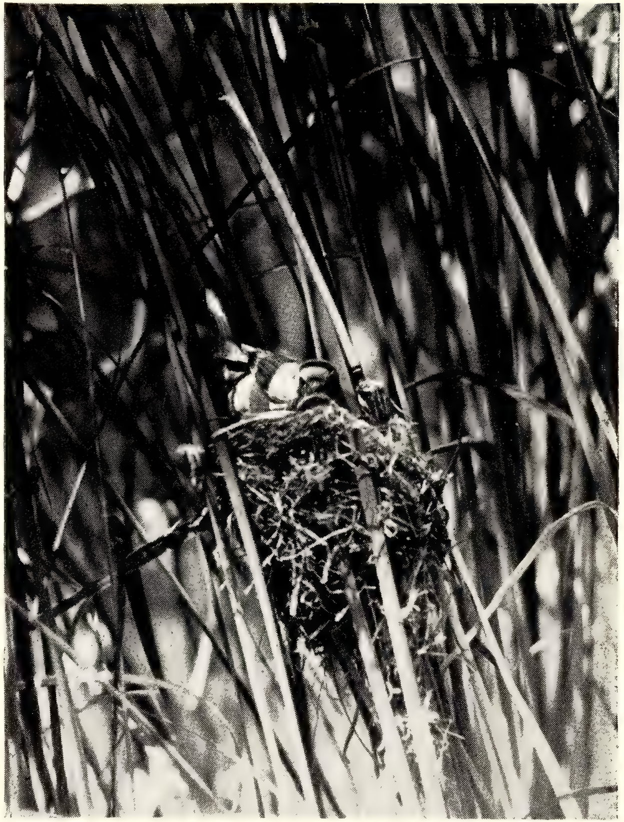
PLATE I.



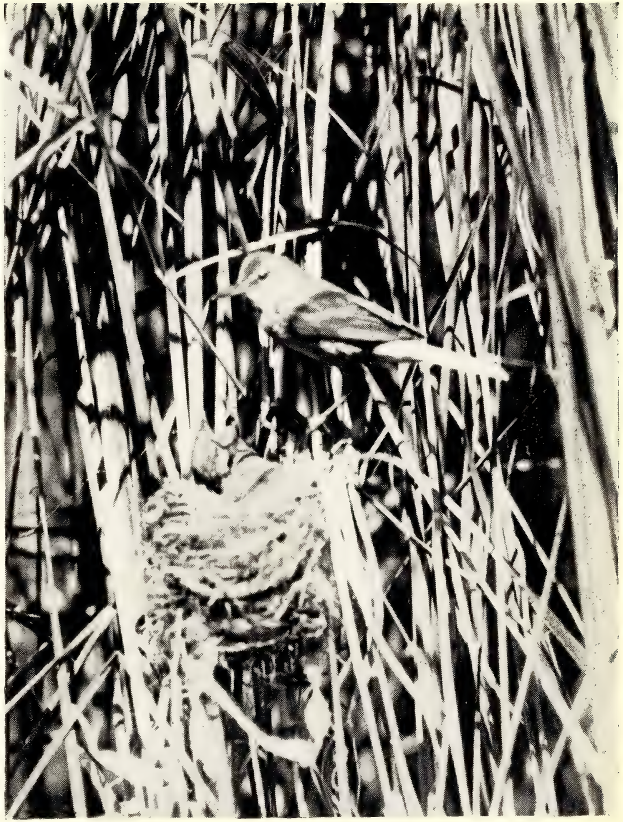
" Waiting for the male to remove his presence, which he did without noise or hurry."



" He assumed what I came to call the ' on guard.' "



" One of the female as she slipped on to the nest."



" Feeding the only two young ones which condescended to remain in the nest."

as a whole than they were seven or eight years ago. The former probably owing to persecution as their eggs are always collected for foodstuffs, and the latter partly owing to the great increase of traffic, both tourist and otherwise, and partly because the eggs are also collected by the villagers. On one occasion, when near Renawari, an old woman in a shikara who had just left the reeds showed to us a bowl in which were some half dozen Moorhens' eggs and between 20 and 30 Dabchicks', fresh and nearly all quite unstained.

Swallows of course abounded and the brilliantly-hued little Central Asian Kingfishers were as numerous and cheeky as ever, using the duck-boards around the house-boats with complete disregard for the presence of the occupants as vantage points for fishing sallies or for beating to death their victims.

The water in the reed-beds on our side of the canal was somewhat deep and the growth very thick and herein lay the reason for my unpromising start. Wading waist deep and pushing through the reeds with very considerable difficulty was the order of the day and meant that thorough searching was out of the question, so I probably missed a number of nests in consequence, though I am also certain that these same two factors were not to the liking of the birds. All I could find was an apparently half-finished Little Bittern's nest and an empty Reed-Warbler's, both close to the boat. As a matter of fact I later discovered that had I waded but four or five yards beyond this Bittern's nest I would have come upon another containing newly-hatched young.

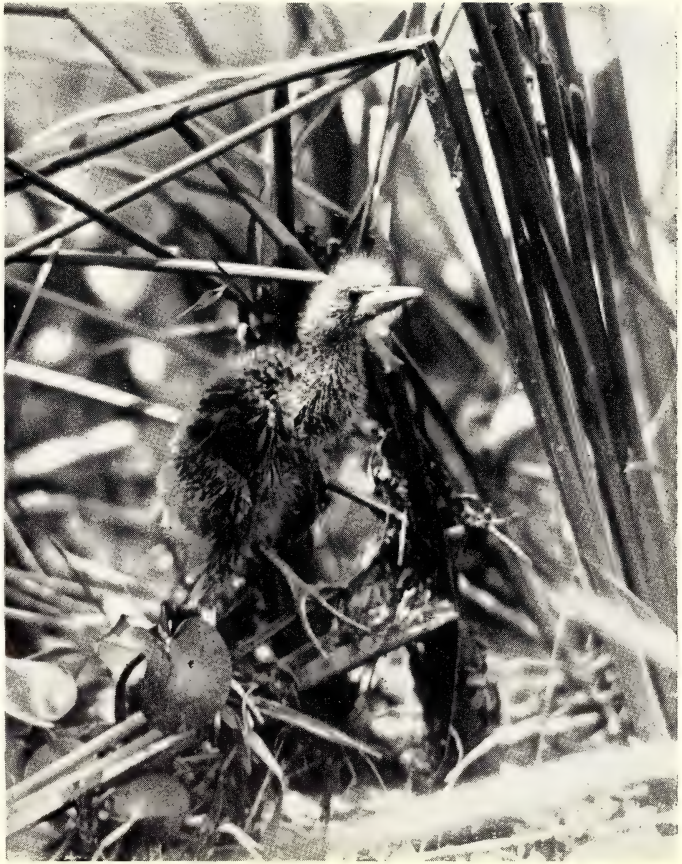
At midday on the 20th, when returning with my wife from a shopping expedition, I noticed a Reed-Warbler's nest in a very unusual position. Owing to the wind and the current—the Lake was abnormally full—the shikara was hugging the west side of the canal, so I was studying each reed-bed as we slowly made our way up stream and thus spotted the nest in question. The Great Indian Reed-Warbler, though bolder than most of his tribe, is still a confirmed skulker and prefers to be heard rather than seen, consequently the nest too is almost invariably well within the outer fringe of the reeds amongst which it is built and which are used to support it. This nest however was not only on the outer fringe but was not even supported by reeds, though a couple of bent ones ran through it in the usual manner but almost horizontally. It rested on a fork of a branch of a small willow tree which had been pushed right over and lay partly in and partly out of the reeds. The nest was thus in full view of passers-by. It was empty much to my regret and still incomplete though both birds were in attendance at the moment of discovery. Unfortunately next morning a house-boat tied up with its prow almost touching the nest with the result that the foolhardy birds naturally deserted. This event however led to me abandoning the reed-beds on our side of the canal in favour of those on the west side, as the water around this nest was barely a foot deep.

That same afternoon therefore I transferred my activities to an area directly opposite the house-boat which proved so productive that one small corner thereof occupied my complete attention for the remainder of our stay in Srinagar. I did not wade straight into the reeds from the side facing the canal but had the shikara pushed up a narrow ditch partly dividing this patch from the next, down the middle of which ran a line of small willow saplings. In one of these was a White-cheeked Bulbul's nest containing 4 eggs. Having left the shikara, I had not waded more than 15 yards into the reeds in about 2 feet of water before I found myself confronted by a Little Bittern's nest in which were 5 well incubated eggs, quite warm to the touch showing that the sitting bird had just vacated the nest though I had not heard a sound. The nest was roughly 8 inches across and 18 inches above the water and composed of dead rushes as well as of the growing reeds bent down and across to form a lattice-work platform.

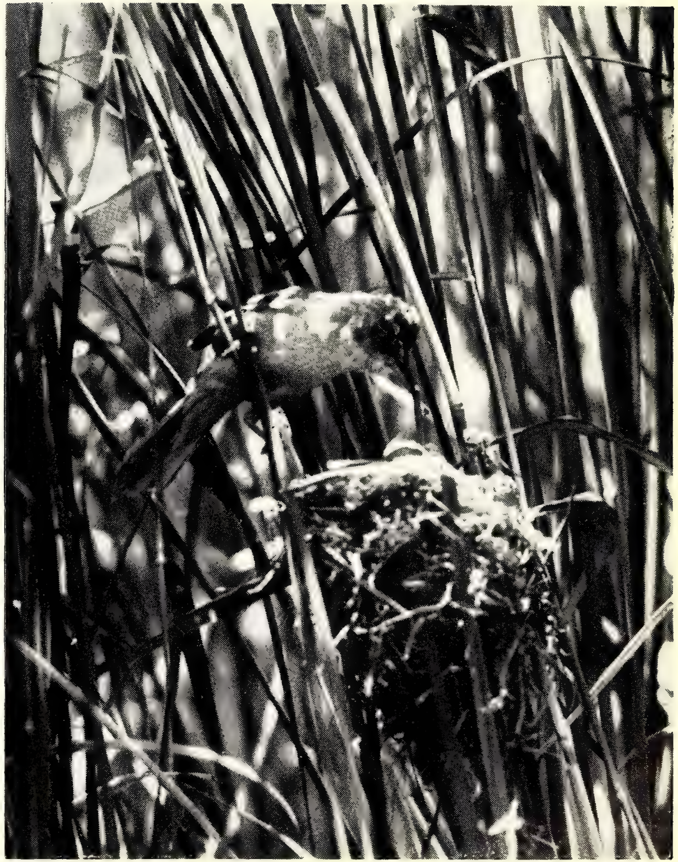
I continued my way through the forest of reeds which blocked out all but a narrow patch of sky above my head and consequently made it rather difficult to maintain direction or keep count of distance, not unimportant items when it is necessary to visit a nest a second time. Soon a lane is formed, but not necessarily on one's first venture as one is continually veering from side to side to look at supposed nests or investigate suspicious noises, added to which in one's wanderings a maze of passages is soon made which cross and recross one another at all angles.

After coming upon 3 more Bitterns' nests, none containing eggs however, I reached a minute pond, a little space clear of reeds some 15 yards long and 3 or 4 wide. I felt it was a good locality for a Moorhen's nest and I was not disappointed. A nest containing 7 eggs, very boldly-marked ones, was situated about 6 feet from the edge of the pond. It was a very substantial nest more or less solid from water level even though the top of it was a good 2 feet from the surface. The eggs were so very near hatching point that the shell of one showed numerous cracks culminating in a ridge where the downy baby was attempting to thrust its way out. I had the half-plate camera produced and used up 2 plates, the exposures employed being F32 and 10 seconds and F44 and 5 seconds. The former resulted in a badly over-exposed negative and the image on the latter flashed up far too quickly for my liking. I was without a watch so my supposed 10 and 5 seconds were probably somewhat exaggerated. On the way back to the shikara I came across a new but empty Reed-Warbler's nest about 20 yards from the original Bittern's.

About 6.30 p.m. I again visited the Bittern's nest, towing behind the house-boat shikara the minute shikara I had hired to support the hiding-tent. This boat was most conveniently the same width as my hide, that is 2 ft. 6 ins., so it was an easy matter to erect the latter firmly upon it. The hiding-tent occupied the central portion, the two ends sticking out into the reeds also requiring to be camouflaged when the boat was in position in front of a nest. With the help of the man whose services I had also hired with the shikara we soon had the tent in position, as narrow a lane as possible having been cut through the reeds from the nest to the spot in the side of the hiding-tent whence the enormous eye of the camera would protrude. The tent was rapidly screened by drawing numbers of the growing reeds through the rope loops caught to its sides, and the ends and top were likewise covered with reeds cut at



"The remaining ones were discovered clambering about the reeds."



"She exposed them to his wondering gaze."

" Supported herself on the nest in the same attitude as the male."

" Shielding the young ones, two of which were having a heated altercation."

a distance so as not to disturb the vicinity of the nest. A number of rushes were then laid over the bare ends of the shikara. It was now getting dusk, so we left the reed-bed fairly confident that however shy or suspicious the Little Bitterns might be they would return to the nest at nightfall and certainly be accustomed by next day to the proximity of the hide and the small clearing running from the nest to it.

By 7 o'clock next morning I was enclosed in the hiding-tent, and very comfortable I was too as I was able to sit on the narrow seat in the shikara looking straight down into the focus sing screen of the reflex. I had been much relieved to find the eggs warm so knew my fears of desertion to be needless. Hardly had the sound of the boat shikara died away in the distance, taking away the men who had tucked me in so to speak, than I suddenly became aware that the head of the female was poking up over the back of the nest to be followed by the rest of her body as she clambered in a peculiarly slow and sure manner onto the platform and settled on the eggs. I was disappointed to find how extraordinarily low she snuggled down in the nest, sinking lower and lower by a strange sidelong swaying motion until all I could see was her head and but a fraction of her back. This swaying she kept up for a minute at least and repeated at intervals. Sitting thus I exposed 2 plates only on her and then waited for developments. She was very restful and showed little interest in the lens, except for staring rather fixedly at it whenever I made a noise. On occasions she thrust out her head and neck in a rather threatening manner towards a fussy little Reed-Warbler which ventured on one occasion to within a couple of feet of her.

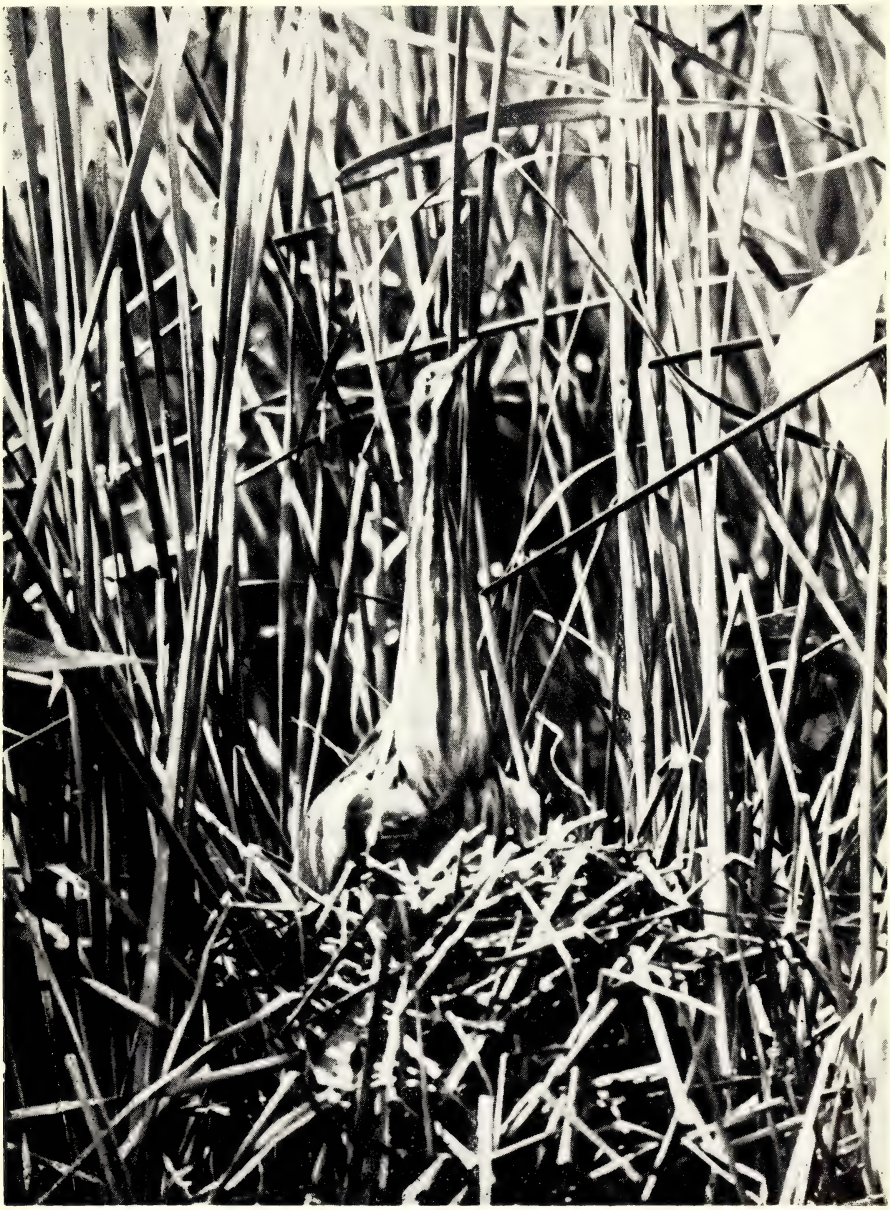
I was just beginning to feel symptoms of boredom coming on when the female showed distinct signs of liveliness. The reason was soon forthcoming ; a slight rustle behind the nest presaged the arrival of the male. The female seemed to resent his intrusion and remaining seated in the nest turned her head towards him, opening her bill and giving one the impression of hissing at him with anger though I heard no sound. The male paid no attention to this display but advancing steadily stepped on to the edge of the nest and remained standing there until she very reluctantly made way for him.

As soon as she had gone, the male took over the care of the eggs and swaying gently in the same manner as she had done he sank down on the nest. He gave one the feeling of being not altogether an adept at the self-appointed task, as he sat very high in the nest and was decidedly prone to nervousness. The lens engaged his attention for a considerable time, and with his bill pointed upwards at an angle of about 45° he gazed fixedly at it from under this dagger-like weapon, giving one the impression that his eyes were set in his head actually lower than the line of the gape. In this position I photographed him using a stop of F8 and 1/15 second but as it was still barely 7.30 a.m. the negative turned out to be slightly under-exposed though the plate was an Iso-Zenith. He did not remain seated for long but after about 10 minutes left the nest for a brief space, to my surprise returning with a length of dead reed with which he proceeded to repair a portion of the nest which evidently did not meet with his approval. This done he spent a further 10 minutes over the main duty and then left the nest once more. I could hear him paddling in the water only a couple of yards behind his home and after an absence of 3 minutes he reappeared, without the further piece of building material I had expected.

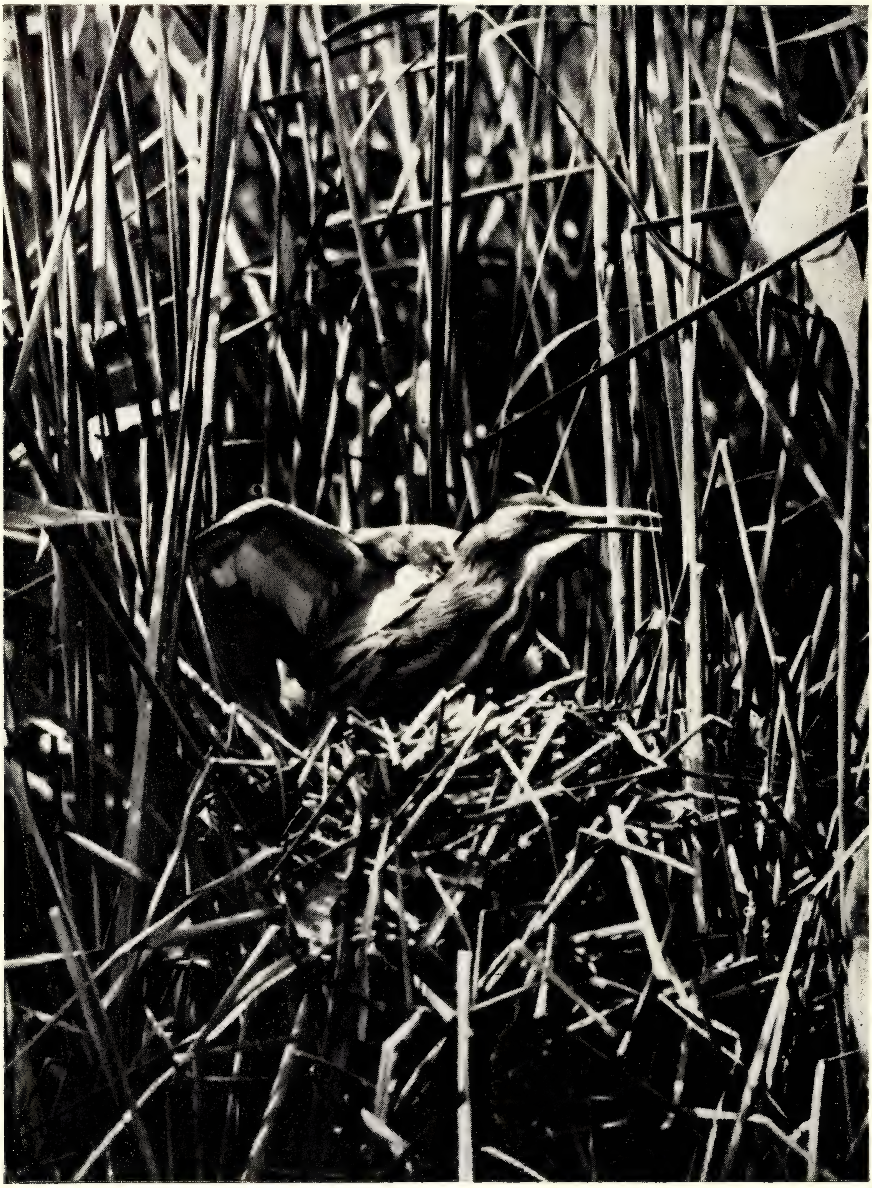
During the time he was incubating he was never still but forever looking this way and that for possible enemies. At every sound he assumed what I came to call the 'on guard'; neck outstretched and bill forming one line with it, obviously ready to impale upon its sword point any intruder with which he could contend. Should a Kite or Crow pass over head, with amazing speed his bill was pointing skywards with his neck stretched to impossible limits. From assuming this position of readiness he withdrew with a steady movement but extreme slowness, some seconds elapsing before his head was back in the normal position tucked well in between the shoulders with the invisibly-coiled neck within the mass of feathers over his breast. It was now breakfast time so not wishing to frighten him unduly by a sudden appearance I put a finger out of a spy-hole and waved it about. The one and only effect was an immediate assumption of the 'on guard,' so I shouted to the Manjhi who was now waiting for me outside the reeds to wade up to the tent. My shout merely produced a lengthening of the neck, and not until the boatman was some 10 yards from the hide though still out of his sight did the Bittern slip noiselessly from his possessions.

We towed away the hide-boat as my programme for the following day was to attempt the Moorhen's portraiture before breakfast and afterwards to pay a visit to the Nishat Bagh, taking note of the extensive weed and lotus patches around there with a view to possible Jaçana photos and to see at what stage the nidification of the Whiskered Terns had arrived. Unfortunately I did not take the hide-boat across in the evening, as the behaviour of the Moorhens when I found the nest had led me to believe that they would give me no trouble, especially as I knew that at least one young one would have just hatched out. On my finding the nest one of the birds had made great demonstrations to draw me away from the locality, clucking loudly and flopping repeatedly and heavily into the water with loud splashes only a few yards away out of sight in the thick reeds.

Next morning therefore I got up fairly early so that by 7 a.m. I was within the hide with everything in readiness. The bird—I could only be certain of the presence of one—approached almost immediately but for two hours it dared not clamber up to the nest. On one occasion only did I catch a glimpse of it some 6 ft. from the hide but well out of the line of the 4 inches wide lens, the obvious cause of its timidity. Its approximate position was easy to divine as the one and only chick as yet hatched displayed remarkable energy, forever turning itself round to face towards the direction of its longed-for parent and doing its very best to scramble out of the nest in which it very nearly succeeded.



" An exhibition of the amazing lengths to which she was able to extend her neck."



" Perturbed at the presence of the Reed-Warblers."

Fortunately it became entangled in the loose outer material of the platform whence it was rescued at 9 o'clock when hunger overcame my keeness. Removing the lens and camera, I pulled the reeds across the passage from hide to nest leaving the tent in position for another attempt next day. Success was not to be however. On my visit 24 hours later the chick had been removed and the nest obviously deserted. Thus it is that we live and learn. The bird-photographer's motto should be ' caution ' and he should never take anything for granted.

The Reed-Warbler's nest on the edge of my reed-bed had also been given up, so once more was the hide placed in front of the Bittern's nest as I wished for records of the relief between male and female. On this day however, the 22nd, the female alone appeared. Completely oblivious to the presence of the camera and hide she amused herself and me until I had to quit, leaving the nest on a couple of occasions and once or twice putting in a short time on household repairs. This time the hide was left *in situ*, not for further immediate work on the Bitterns but because a Reed-Warbler's nest containing 4 fresh eggs had been come upon while cutting rushes with which to camouflage the tent, and being but 15 yards to one side of the Bittern's nest I did not see the sense in taking the hide to the house-boat only to have to bring it back again at nightfall. At dusk therefore we merely drew the hide-boat the few intervening yards and placed it in position facing the Reed-Warbler's abode. Passing the Bittern's nest on the way back I could just make out through the intervening reeds one of the birds at the ' on guard ' on the nest, so used were they becoming to our comings and goings.

The morning of the 25th had now arrived and I was awaiting what I expected to be an easy task, namely the return to the nest of the Reed-Warbler. Nevertheless for 2 hours I sat there with both birds making incessant harsh noises around me. The hide was not at fault as on occasions the roof was used as a landing ground and once one of my Little Bitterns actually clambered over the end of the boat. It was the lens once more. Gaining experience from this second failure, I have since employed a circle of dull black paper, which, though the same diameter as the lens, is yet not so startling on account of its lack of lustre and flatness. Nevertheless it appears to be what is needed and when the projecting Dallon lens is substituted for it alarm is not occasioned.

Eventually I carefully withdrew the lens into the hide while the birds were behind me and but 5 minutes later one of them was seated over its eggs. To replace the lens was easily accomplished as the head of the bird was so low in the nest that it was unable to see the slit through which I had to push it. This fact of course also went against me as I wanted photos of the bird, not of a bill and tail pointing almost vertically upwards. The shikara now being in the offing, I called up the boatman hoping to get the bird as it became alarmed at his approach, but on his arrival it sat up in the nest with great suddenness and flew off without giving me the necessary interval of time for an exposure. Be it noted that my voice caused no alarm.

Determined to succeed I left the tent where it was and 24 hours later I returned once more. Five photographs were my reward though only 3 of them, all obtained with an exposure of 1/50 second at F5·6, turned out good enough to keep; two of the male looking down at and admiring his possessions and one of the female as she slipped on to the nest. I think I am correct in presuming to distinguish their sexes as one bird did all the incubating, the other merely approaching the nest to take stock of its contents—seemingly without parallel in his opinion—when exposed to his wondering gaze. I tried hard to get photographs of the two birds together, but found it impossible to get both in focus at one and the same time.

The entire time I was in the hide I was periodically bewildered by hearing the unmistakable squeaks of young birds being fed, but cooped up in the small tent I found it almost impossible to determine the direction whence the sounds came. However by throwing caution to the winds and poking out my head, I was able to ascertain that not far behind me in the reeds there must be another Reed-Warbler's nest. Such was the case. It was within 5 ft. of the path from the Bittern's nest to the one I had just been operating upon but it was low down and the rushes were very thick. It was obviously the owners of this nest who were wont to annoy my Bitterns, as the two domiciles could not have been more than 15 ft. apart. The parents were inordinately tame and, when I stepped back a couple of feet into the reeds on the opposite side of the path, one of them actually came to the nest and fed its rowdy offsprings.

This determined me to try a method I had as yet never employed to get records of the proceedings, and let me say here and now that as long as I live never again will I try the cloth over the head or any other like method on a hot summer's afternoon, this side of Suez at any rate. I have seen photographs of people observing the ways of wild creatures standing up with portions of tree trunks, sacks and other strange implements over their heads. I take off my hat to them. Never in all my life have I spent such an uncomfortable 40 minutes as I did then to obtain 4 decidedly mediocre negatives of this Reed-Warbler feeding the only two young ones which condescended to remain in the nest. The other two clambered out and disappeared into the reeds soon after I had taken my stance in front of their home. By next morning the nest was empty. However to go back to my self-inflicted torture.

I went over to the spot just after a very good lunch on top of which a sleep would have done me much more good, I'm sure, than being stewed alive. I fixed the reflex on to the stand of my half-plate camera, screening it as much as possible in the reeds just on the opposite side of the above-mentioned path we had formed through the rushes, taking my stand behind it. The water was just knee deep, so within less than three minutes a number of water-beetles and other small insects were tickling the backs of those portions of my anatomy, nearly driving me off my head. To bend down to remove the offending things was out of the question, as the slightest movement produced much alarm and a volley of chattering from the parent Warblers creeping about in the reeds in close proximity and obviously delayed their appearance at the nest. However this discomfort was nothing compared with that of the mosquitos and the heat. I was very soon reminded of the fact that I had forgotten to smear myself with oil of citronella, and of course just at a critical moment as one of the birds at last pitched on the rim of the nest a sharp stab on my elbow, another on my cheek and a third on the back of my knee almost made me leap out of the water with anger and pain.

I had first tried merely bending well over the focussing screen so that my face was more or less hidden from the birds by my topi, but they objected to my head-gear's shiny brown top and I objected still more strongly to the sun which shone with appalling ferocity on the back of my neck. There was nothing for it but to drape a large focussing cloth I had brought out with me over my entire head and shoulders and down to the hood of the reflex. With this arrangement the birds agreed but all other discomforts paled into insignificance. After midday the reed-beds were always humid and unpleasantly hot. Within a very few moments therefore I was perspiring so profusely that the focussing screen was rapidly covered with moisture. Ten minutes of this, in which the birds appeared 6 times and in which I exposed 4 plates, were all I could stand. I then fled back to the house-boat feeling a complete wreck and wondering whether fever was to be my subsequent portion for my foolhardiness and forgetfulness. All this time I could not have been more than 3 yards from the Bittern's nest and I could distinctly hear sounds of a bird on it. It must have known of my presence, but was apparently no longer afraid of me.

On my way back to the house-boat and also on a previous occasion in the same place my wife drew my attention to a Central Asian Kingfisher hovering in the air in exactly the same manner as does the Pied Kingfisher. Aim was taken in just the same way, the body being at an angle of about 60° with the bill pointing straight downwards. The plunge which followed was not however quite vertical but at a very steep angle indeed and from a height of roughly 15 ft.

I now come to my last and most interesting morning with the Bitterns. On the 26th 1 egg had hatched out ; on the 27th 3, and by the 29th all 5. It appears therefore that incubation probably commences with the laying of the first egg, especially as I had also under observation another nestful of young ones in which the difference in age was even more marked. This was the nest I referred to earlier on as being quite close to the house-boat. On the afternoon of the 24th I came across this family but only one, the youngest, was content to remain in the nest ; the remaining ones were discovered clambering about the reeds at varying distances from it. Whether this is a normal habit, as they were still in down, or whether my floundering through the reeds set them rambling, of course I have no means of telling. I had all along felt certain that there must be a nest in this corner of the house-boat patch, as not only had I heard occasional croaks, but I had noticed Bitterns to settle in the reeds at this spot quite a number of times, and one had the habit of coming out to fish at the very corner of the reed-bed within a few yards of the boat.

To get back to my pet pair however. As all the eggs were now hatched I had every reason to expect a fully employed morning. They were very lively youngsters and from the first exhibited many of the characteristics of their parents, assuming the 'on guard' with the same alacrity and coming back to normal in the same slow motion. They also gave vent to frequent fits of bad temper, digging at one another with their somewhat blunt bills most viciously. The down on their heads stuck out like the bristles of a bottle brush and of course they varied considerably in size owing to the different dates of their arrival on the scenes. Altogether they were very quaint little creatures.

I had upwards of quarter of an hour to wait before either of the parent birds put in an appearance. The male was the first to engage my attention and I soon made an exposure on him shielding the young ones, two of which were having a heated altercation and refused to be covered up. He appeared to be supporting himself on the shoulders of the wings, thus leaving plenty of room for his offsprings whose wonted activity never ceased incidentally since heads were for ever popping up from under the male's wings or breast. His manner now showed much more confidence and he took little interest in outside matters. For some minutes nothing of note occurred, then however he gave evidence of the reason why the chicks had been left to their own devices for at least quarter of an hour. Depressing his bill almost onto the breast he proceeded with very little effort to disgorge a fish. The food however was not allowed to fall to the ground as a young one at once seized his bill in its own minute appendage and seemed to follow the fish down from the gape to near the extremity whence it passed into the youngster's gullet. This method of feeding made it distinctly difficult for me to make out the state and size of the fishes disgorged, but I judged them to be about 2½ inches long though one was undoubtedly larger. Four fishes having been thus transferred his stock was evidently finished, thus leaving one young one unfed, that is presuming that each fish had been handed over to a separate chick, a matter which I was unable to determine.

At 10.45 a.m., that is half an hour after the advent of the male, a slight rustling was followed by the appearance of the female, who stepped on to the back of the nest and stood there in a most dejected attitude waiting for the male to remove his presence which he did without noise or hurry. They were exceedingly silent birds and on only one occasion did either of them give vent to a sound of any sort while on the nest and then only to a single low croak. I cannot remember which of the two it was. As on the previous relief I had witnessed he seemed to take little notice of his spouse, and clambering off the edge of the nest disappeared into the reeds in what one might almost describe as a surly manner. This was the moment I had longed for on every one of my visits but to get the photograph showing both birds in focus was no easy matter. The moment I heard her coming I hurriedly altered stop and exposure to F4 and 1/90th second and was ready only just in time to press the release as the male's body moved out of the way of hers. A fraction of a second later he would have been in the reeds and as it is his head is partly screened by them. However I think I got the photograph at the only possible moment as had I taken it earlier his body would have got in the way.

Since the occasion of my last visit they appeared to have exchanged characters. She was now the nervous one, continually on the look out for the advent of enemies, and I had a most amusing and instructive time watching her extraordinary postures. At first she supported herself on the wings in the same attitude as the male, and I did my best to secure a portrait as like as possible to the first one taken of the husband, a comparison of the two showing off well the difference in colouration.

After a short space of time she also disgorged two portions of food, one of which was certainly a fish of more than 3 inches in length. This food was passed on to the young ones in the same manner as previously. No other food was given them while I was present. Thus in nearly 4 hours each young one received a single meal—one of them I presume had two—consisting of a small fish between 2 and 3 inches long.

After picking a large fly off an adjacent reed with amazing speed of movement, making an unsuccessful snap at a daddy-longlegs, and eventually disposing of an incautious dragon-fly, she gave me an exhibition of the amazing length to which she was able to extend her neck. I was unable to decide on the object of her suspicion but think it must have been a thieving crow, as on my way to the hide I had remarked the last scenes of a tragedy. Noticing the Crow with an object in its bill fly from beneath the Bulbul's nest in the willow, the eggs in which I knew had been hatched for a couple of days, I looked inside the nest and found it on one side and empty. At any rate whatever the cause, it appeared to be behind the tent and possibly the Bittern was endeavouring to see over the obstruction. From the 'on guard' her head shot up a number of inches and then continued to move upwards in a series of jerks, each jerk lengthening her neck about quarter of an inch, until her appearance bordered on the comic. With each jerk the feathers were more and more flattened against the sides of the head and neck until the latter tapered almost to a point and her head looked absurdly small. Knowing that the downward movement would be exceedingly slow I was able to wait until it just commenced, thus being certain of a photograph showing the neck stretched practically to its utmost limit.

It was now about midday and, as I had bent back and cut some of the reeds around the nest to avoid annoying shadows falling across the birds, she obviously began to feel the heat. Her first action was to half open her wings to afford further protection to her young ones and soon she began to gape in the way birds do when feeling the effects of a hot sun. It was thus that I obtained the photograph in which she appears to be warding off with such fierceness an attack from the flank. In reality she was merely slightly perturbed at the presence of the Reed-Warblers which were feeding one of their young ones rather closer to the nest than she considered quite permissible, and so unhurried were her movements that this photograph was obtained with an exposure of 1/20 of a second at F8, the plate having an H & D speed number of 400. A few minutes later I left the hide, bent a number of reeds over and around the nest and left her and her absent husband to bring up their family in peace.

A NEW SPECIES *OF GYNAIKOTHRIPS* FROM BANGALORE, INDIA.

BY

DUDLEY MOULTON

San Francisco, California

GYNAIKOTHRIPS KANNANI, sp. n.

Female holotype ;—Colour dark brown. Antennal segments 1 and 2 concolorous with head except a lighter area near base of first segment and tip of second which are lighter, 3 to 6 yellow and shaded darker in the distal portions, 7 yellow in basal two-thirds, grey-brown in distal third, 8 grey-brown. All femora blackish brown, four tibiæ yellowish brown at base shading to clear yellow at tip, middle tibia dark brown in basal half, hind tibia in basal-three-fourths, otherwise rather abruptly yellow, all tarsi clear yellow. Wings transparent except for grey clouding at base. Body and basal wing spines dark brown.

Total body length ·3 mm. (body distended) ; head length ·38 mm. width ·21 mm. ; prothorax ·18 mm., width, including coxæ, ·38 mm. ; pterothorax width ·48 mm. ; greatest width of abdomen ·45 mm. ; tube length ·26 mm. Antennæ : length (width) i. 33 (42) ; ii. 57 (33) ; iii. 99 (30) ; iv. 120 (39) ; v. 114 (31) ; vi. 84 (30) ; vii. 63 (21) ; viii. 30 ; total length 600 m Length of spines : postoculars 30 m. on anterior angles of prothorax 36 m., on anterior margin 30 m., mid-laterals 60 m., on posterior angles, outer 105, inner 39 m., on ninth abdominal segment 150 m., at tip of tube 240 m. Basal wing spines, 60, 66 and 75 m. respectively.

Head 1·8 times longer than wide with straight, almost parallel sides, apex swollen, vertex with numerous indistinct transverse lines. Postocular spines very short and inconspicuous. Eyes large, prominent, occupying ·36 the length of the head and together ·66 its width. Ocelli large, their diameter three to four times larger than facets of eye. Posterior ocelli contiguous with anterior inner margins of eyes, anterior ocellus on swollen vertex and slightly overhanging basal antennal segments. Mouth cone short and broadly rounded, extending two-thirds over prosternum. Antenna slender, 1·6 times longer than head, segments 3, 4 and 5 each more than three times longer than wide ; sense-cones long, slender and pointed.

Prothorax ·5 its width and ·5 length of head. Pronotum sculptured with closely placed wavy lines. Normal spines stout, with blunt tips, those on anterior angles short, mid-laterals longer and outer spines on posterior angle longest, inner spine on posterior angle approximately ·3 as long as outer. Pterothorax with evenly formed arched slides. Legs slender. Fore tarsi unarmed. Wings with parallel sides 11–12 double fringe hairs on posterior margin of fore pair, three basal wing spines stout and conspicuous by their dark brown colour.

Abdomen long and slender. Tube ·7 the length of head and three times longer than width at base.

Male allotype : Similar to female in colour and shape Total body length 1·3 with abdomen distended. Spines on posterior angles of ninth abdominal segment 60 m., those along posterior margin 126 m.

This species is most closely related to *G. claripennis*, Karny, but is easily separated from that species by its longer head, more elongate intermediate segments of antennæ and the stouter anterior angular and mid-lateral spines of prothorax.

Type material : Female holotype, male allotype, six ♀ and four ♂ paratypes taken on *Eugenia* sp., May 4, 1927 (Dr. K. K. Kannan). I take pleasure in naming this species after the collector. Types in author's collection (Moulton No. 2196).

Type locality : Bangalore, Province of Mysore, South India.

NOTES ON SOME INDIAN LEPIDOPTERA WITH ABNORMAL HABITS

BY

DR. T. V. RAMAKRISHNA AYYAR, B.A., PH.D., F.Z.S.

Madras Agricultural Department, Coimbatore.

It is a fact well known to all entomologists that the great majority of butterflies and moths (Lepidoptera) are plant feeders, either found on growing plants or breeding in dry vegetable matter ; a few are also found on clothes, wool and fur, but very few exhibit the abnormal habit of living in company with other insects and often at the expense of the latter. While instances of Lepidoptera which are subject to the unsolicited attentions of other insects, especially of parasites and predators of sorts, are numerous and quite common all over the world, examples of moths or butterflies which seek the company of other insects and live in association with them appear to be comparatively few ; and in some of the known cases our knowledge of the mutual relations between such hosts and guests is also quite imperfect. In spite of these facts, the few Lepidoptera that exhibit such abnormal habits are not uncommon in different parts of India, and observations on their bionomics go to show that some of them are also of economic importance. This paper presents a brief record of some of the observations made by the writer on the bionomics of a few such Lepidoptera with curious habits noted so far from South India ; incidentally a few records of such examples noted by others in different parts of India are also included, the idea being to make the whole paper a brief summary of our knowledge of entomophilous or entomophagous Lepidoptera recorded so far from India.

Butterflies.—Among the Rhopalocera the Lycænid species *Spalgius epius*, West. is the only insect so far known, which has been found to seriously interfere with the economy of other insects. The caterpillar of this butterfly, unlike other known forms of the group which are free living and mostly phytophagous, is predaceous on different kinds of mealy bugs. It has been noted on the often injurious mealy bug *Phenacoccus iceryoides*, Gr. in Coimbatore and in other parts of India; and in Ceylon Green [1] has noted it on *Phenacoccus glomeratus*, Gr. and *Pseudococcus lilacinus*, Ckll. Recently in Coimbatore the butterfly was found in numbers on the mealy bug *Pseudococcus citri*, *R.* which was badly infesting some Agathi (*Sesbania grandiflora*) plants and also on *Phenacoccus iceryoides*, Gr. infesting plants such as *Pithecolobium saman*, *Odina odiar* and *Dolichos lablab*. The thick set fleshy caterpillar with the hidden head and limbs and covered with a white mealy coating slowly moving in the midst of a colony of mealy bugs forms an excellent example of insect camouflage and is often mistaken for a mealy bug. The naked chrysalis into which the caterpillar changes and which is found generally attached to the plant surface on which the host and guest are found, presents a curious appearance to the casual observer; it is not unlike the face of a monkey in general contour and is known as the monkey face pupa[1] ( ). The colour is dark greyish with a mealy pubescence here and there over the surface. The adult butterfly that emerges out of this monkey face pupa is of medium size and has dark brown wings with a pale white spot on each fore wing. Sometimes swarms of these butterflies congregate on plants where there are masses of mealy bugs, evidently for the purpose of oviposition. From observations made, one is led to infer that this insect plays the part of an efficient natural check on some of the destructive mealy bugs, and attempts may be made whenever possible to test the efficacy of the insect by utilizing it by artificial methods.

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[1] E. E. Green, *Coccidæ of Ceylon*, vol. v, p. 396, 1922.

Speaking of lycaenid larvae, it is not uncommon to find some of them associated with ants of different kinds; the writer has noted this particularly in the case of the *Zizyphus*—leaf caterpillar *Tarucus theophrastes*, F. But in such cases it will be found that the ants seek the caterpillar for some sweet secretion, and as such, the caterpillar is only the passive agent and not the aggressive or active party, as in the case of *Spalgius*.

Moths.—Coming to the group of moths, over half a dozen Indian forms are so far known living in active association with other insects, and in some cases causing definite injury to the hosts. Of the latter, some of the species of the noctuid genus *Eublemma* are the best known and very widely distributed. The caterpillars of these species are predaceous on different kinds of scale insects, and in the case of those Coccid hosts which are bad pests of different cultivated plants, the caterpillars often act as very effective natural enemies. The following Coccid feeding species of *Eublemma* are known from India and Ceylon :—

E. coccidiphaga[2] feeding on some species of the scale *Lecanium* in Ceylon, and on the 'lac' insect in North India.

E. vinotincta[3] on *Lecanium sp.* Ceylon.

E. amabilis[4] on Lac insect. All over India and Ceylon.

E. scitula in South India[5] and probably in North India too.

Of these forms *E. scitula* R. has been noted to be commonest in South India. In Coimbatore the writer has bred this moth from caterpillars found predaceous on

1. *Pulvinaria maxima*, Gr. a pretty bad pest of Nim (*Melia*) trees in and around Coimbatore.

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[1] E. H. Aitken, *Bombay Natural History Society Journal*, vol. viii, p. 485, 1894.

[2] G. Hampson, *Catalogue of Phalanæ, British Museum*, vol. x.

[3] *Ibid.*

[4] C. S. Misra, *Bulletin on Lac*, Pusa. (No. 142), 1923.

[5] Ramakrishna Ayyar, *Memoir on Pulvinaria maxima Gr., Pusa Ent. Memoirs*, vol. vii, 1925.

2. *Anomalococcus indicus*, Gr. equally bad on 'Babul' tree (*Acacia arabica*) in and around Coimbatore.
3. *Ceroplastodes cajani*, Gr. a pretty bad pest on *Ocimum sanctum*, Red gram, Lablab, etc.; also in different parts of South India.
4. *Ceroplastes ceriferus*, A. The Indian white wax insect found on various plants, *Lawsonia*, Mango, etc.
5. *Tachardia lacca*, K. On *Zizyphus*, Rain tree, *Butea*, etc.
6. *Lecanium hemisphæricum*, T. On Ferns, Sandal Wood, Guava, etc.
7. *Pseudococcus lilacinus*, Ckll. On *Ailanthus excelsa* shoots.

This insect has been noted on *Pulvinaria psidii*, Gr. and *Lecanium hemisphæricum* also in Mysore.[1] In Coimbatore it is not found so commonly on *spp.* of Lecanium as on *Pulvinaria maxima*, *Anomalococcus indica* and the *Lac* insect.

Though in the case of Coccid pests the *Eublemma* caterpillar performs the function of a beneficial agent, in the case of the *lac* insect which is useful to man, this moth unfortunately proves a serious pest by devouring the lac scale and the lac encrustations; in some tracts the ravages of this caterpillar are so very bad that its control and prevention from being carried from place to place with brood lac, have become serious problems. In South India an interesting Braconid wasp[2] (*Aphrastobracon flavipennis* Ashm.) has been discovered by the writer as a parasite on the predatory *Eublemma* caterpillar. This parasitic wasp, therefore, is a useful agent in the case of the *Eublemma* caterpillar on lac, while it is not so when the caterpillar infests plants of economic importance. The life-history of *E. scitula* is practically similar to that of *E. amabilis* described by Misra.[3] On stems and shoots, covered by the host insect, the moth lays its egg singly in the midst of the scales, often on the bodies of the latter. The eggs are of a shining pinkish brown colour with a bluish tinge, spherical in shape, and beautifully sculptured. The caterpillar that hatches out feeds on the soft portions of the growing scales one after the other and covers its body with a case or house made up of the empty scales of its victims cemented together. With this covering the creature moves like a limpet among the colonies of scales, especially when the host is a *Pulvinaria* or *Lecanium* and devours the soft parts of a number of these latter. The presence of this predatory enemy on a scale infested branch can be easily made out by the sickly appearance of some of the growing female insects inside which the young caterpillar might be feeding, or in other cases by the presence of the conical houses of the caterpillar which are distinctly bigger than the scales around; the characteristic locomotion of the caterpillar drawing the house with it is also another indication. The larva becomes helpless without this dome-shaped covering and its body has become adapted to occupy this artificial house. The posterior region of the abdomen becomes swollen and gets attached to the inner surface of the shell by means of the muscular suckers provided with numerous horny hooks. The head end is narrower. The prolegs are reduced to three active pairs including the two anal claspers transformed into suckers for fixing on to the shell. The body becomes fleshy and plumpy. A full-grown caterpillar has a pale fleshy-brown colour with the head, prothoracic shield and the tips of the thoracic legs shining black. It measures about 6 to 6·5 mm. just before pupating and the colour becomes greyish-white. Pupation takes place inside the dome-like house itself, which is turned by the larva into a cocoon by the closing the ventral opening of the shell with a pale white screen of silk. The chrysalis taken out of the coccoon measures 6 mm. and is of a light greenish-brown colour soon after pupation. It is cylindrical with the anterior end roundish and the posterior bluntly pointed ; the latter bears five short brown bristles arising from small chitinous tubercles. The moth is a small pale white insect with olive brown marks on the wing. In certain seasons it is not an uncommon sight in and around Coimbatore to find stems and branches of *Acacia* trees infested with the scale *Anomalococcus indicus*, Gr. covered with clusters of *Eublemma* cocoons by the thousand; of course, the caterpillar often harbours its own enemy in turn, viz. the braconid wasp mentioned above.

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[1] Coleman and Kannan, *Scale Insect Pests of Coffee in S. India*, 1918.

[2] Ramakrishna Ayyar, 'The Genus Aphrastobracon', *Bull. of Ent. Res.*, vol. xviii, 1926, p. 91.

[3] C. S. Misra, *Bulletin on Lac*, Pusa, 1923 (No. 142).

Before leaving Eublemma it may be worth while pointing out that *E. scitula* R. is one of those natural enemies which had attracted the attention of pioneers in the biological method of pest control some years ago ; under its other name *Erastria scitula* R., material of this insect was transported from Italy to California[1] for trials in checking the Olive scale *Lecanium cleæ* in that state. Another species of Eublemma—*E. gayneri* Rot is recorded by Hall[2] as a predator on the mealy bug *Phenacoccus hirsutus* in Egypt.

The interesting but little known family of moths called *Epipyropidæ* includes species of caterpillars which have been noted to live in close association with different forms of homopterous bugs. Fletcher's[3] account of the known Indian forms gives some information about this family in India. Hardly anything definite is known regarding their bionomics, especially as to whether the caterpillar causes any injury to the homopteron or merely lives on as a scavenger or a help-mate. *Epipyrops polygrapha* H. and *E. eurybrachides*, Fl. are two definitely known Indian species both bred from the fulgorid *Eurybrachus tomentosa* in Coorg and Coimbatore.[4] Species of *Epipyropidæ* have also been noted in Central Provinces and Mysore. In a paper on ' The Natural Enemies of the Mangohopper (*Idiocerus* spp.) ' in Mysore by my brother T. V. Subramanium there is a record of an Epipyropid which is described as a new species

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[1] *Insect Life, U.S.A.*, vol. vi, p. 10, 1894.

[2] W. J. Hall, *Bulletin 17, Ministry of Agriculture, Egypt*, on ' Hibiscus Mealy Bug ', p. 25, 1921.

[3] T. B. Fletcher, *Report of the Third Entomological Meeting*, Pusa, 1919.

[4] *Ibid.*

(*Epipyrops fuliginosa*) (see pp. 466 and 468 of *Bull. Ent. Res.* xii, 1922). Recently while engaged in observing the bionomics of a fulgorid *Ricania bicolorata* a minor pest of coffee and citrus and very common on the Nilgiris early in summer, the writer came across a caterpillar among the nymphs of the bug, which latter possess profuse waxy tassels ; but unfortunately the caterpillar dried up before maturing, probably this was either an Epipyropid or the caterpillar of the moth *Ancylis glycyphaga* Mey. noted elsewhere in this paper. It is not unlikely that more Epipyropidæ will be met with on species of homopterous bugs like *Fulgora*, *Eurybrachys*, *Ricania*, *Kalidasa*, etc., species which are in certain seasons found in swarms along the Nilgiri slopes.

Among the Microlepidoptera a few forms have been noted associated with other insects, but the relationship in some of these cases is still not quite clear. These are—

Ancylis glycephaga, Meyr.[1] noted to breed on the sugary secretion of the homopterous bug *Phromnia marginella* in Pusa appears a doubtful case.

Pammena isocampta, Meyr.[2] noted to feed on scale *Lecanium* sp.; locality—Paradeniya, Ceylon.

Brachmia xerophaga, Meyr.[3] Found breeding in nests of spider living among insect remains and grass ; Madras, a scavenger ?

Anatrachyntis falcatella, St. On the lac insect in Ceylon[4] and on mealy bugs (*Dactylopius*) in Pusa.[5]

Holcocera (*Hypatima*) *pulverea*, Meyr. Noted by cultivators of lac in North India both on the living and stored lac, known to be a very serious pest on lac.

Ancylis and *Brachmia* do not appear to be injurious to the host, while the others are more or less harmful to Coccidae—particularly to the lac insect. In a recent paper by Bassinger, it is found that a moth *Holcocera iceryaella*, for a long time supposed to be beneficial as being predatory on scales has recently been noted as a pest of oranges in California.[6] A fairly well known Microlepidopteron outside India which also attracted the attention of early parasite collectors similar to *Eublemma scitula* R. is an Australian Coccid-feeding moth *Talpochares coccophaga*,[7] Meyr which was taken to California for trial against scale pests.

Coming to the family Pyralidæ, the wax moth—*Galleria mellonella* L. is a notorious pest of bee hives found apparently all over the world. Though it does not directly affect the bees themselves, the insect causes a considerable amount of damage to the hives. The dark brown moth lays eggs on the wax combs often in groups and from there the caterpillars hatch out and feed on the wax. The dirty yellowish white caterpillar which grows to about an inch in length tunnels through the waxen frame work of the combs and covers them with webbing of silk, in some cases the inhabitants of a bee colony are compelled to desert the hive due to the depredation of this caterpillar. It is interesting to note that the wasp *Nemeritis canescens*, Grav, has been recently noted by Richmond as a parasite of the wax moth in Colorado. With the wax moth may be included some sphingidæ, especially the *spp.* of *Acherontia* (Death's-head Moth) which rob the bees of their honey from their hives. Among the Pyralidæ there is another example—a Phycitine moth (*Phycita dentilinella*), the caterpillar of which was first noted by the writer in Coimbatore as early as 1914, often living in association with the chrysalis of a Limacodid caterpillar *Parasa lepida*—the common ' nettle grub ' of South India. This predatory caterpillar appears in numbers in certain years and a good percentage of the cocoons of the Limacodid harbour the predatory larva. The life-history of this predatory caterpillar has not yet been fully observed, but since the caterpillar is found more in evidence inside the cocoons of the host, it appears likely that the predatory moth lays eggs on the nettle grub at an advanced stage just before it begins to spin its cocoon. Cocoons containing the caterpillar side by side with the chrysalis of the host appear somewhat weak and yielding to pressure unlike healthy cocoons which are hard and shell-like ; the predatory caterpillar is short and is of a pinkish-brown colour. This moth has also been recorded from Bengal[1] as feeding on the wild silk worm *Cricula trifenestrata*.

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[1] T. B. Fletcher, *Pusa Ent. Series Memoirs*, vol. vi, p. 45, 1921.
[2] E. Meyrick, *Exotic Microlepidoptera*, vol. i, p. 196, 1914.
[3] E. Meyrick, *Ento. Month. Magazine*, 1914, p. 219.
[4] E. Meyrick, *Bombay Nat. His. Soc. Jour.*, vol. xvi, p. 607, 1905.
[5] T. B. Fletcher, *Pusa Ent. Series Memoirs*, vol. vi, p. 45, 1921.
[6] A. J. Basinger, *Journal of Economic Entomology*, 1924, p. 637.
[7] W. W. Froggatt, *Agr. Gaz. N. S. Wales*, 1910, p. 801.

In September 1924 while collecting and making observations on different Coccidæ in and around the Coimbatore Agricultural College, numerous examples of a giant scale insect (*Aspidoproctus xyliæ*, Gr. *M.S*) were noted on a few rain trees (*Pithecolobium saman*). In the course of a study of this insect in captivity it was a surprise to find that some of these big dome-shaped scales harboured one or more larvæ of a species of Lepidoptera. Numerous specimens of the adult moth were reared out in capitivity and the species has since been kindly identified by the Imperial Bureau of Entomology as *Euzophera cocciphaga*, H. The insect was originally noted in Sikkim and the only information about it in Hampson's description[2] is that ' the larva lives under a Coccid on which it feeds '. A few notes on the bionomics of this insect as studied at Coimbatore are added below :—

One or more caterpillars and pupæ are found inside some of the infested scales. The external indication of a scale badly infested with the caterpillar is the presence of a dirty grey attachment of silk and frass all round the base of the scale fixing the same firmly to the plant surface. In course of time each infested scales become partially dark coloured and sickly. This habit of the caterpillar in binding the scale all round with such an attachment appears to be a device to prevent the Coccid embryos, which hatch out in hundreds

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[1] H. M. Lefroy, *Indian Insect Life*, p. 514, 1919.

[2] G. Hampson, *Bombay Natural History Society Journal*, vol. xviii, p. 262, 1908.

from inside the Coccid, frown crawling out from beneath the mother insect as is normally the case. It was noted that, while from these scales which had the firm silken fastening at the base no embryos emerged even after longer periods, from others where there was no fastening or where the attachment was interfered with and small passages made, the small flattish golden coloured coccid larvæ with their fringe of long hairs characteristic of this scale began to emerge and crawl over the plant surface in numbers. Some of the cemented scales when opened contain two or three caterpillars in different stages of growth or one or two pupæ in tough silken tubular galleries in the midst of dead and partially destroyed eggs and embryos of the host. From observations made so far, the caterpillar appears to be predatory and in order to secure its own safety and conserve its food, which apparently consists of the eggs and larvæ of the coccid, it constructs the firm attachment around the base of its host. The following points so far noted in its life-history may be added. Glistening light greenish-yellow eggs are found laid singly on the dorsal surface of the host insect mostly at the posterior region. The egg is spherical and flattish resembling a scale with the surface beautifully reticulated. Numerous eggs are found laid on single coccids though the exact number laid by each moth was not observed. The young caterpillar that hatches out crawls about the posterior edges of the scale insect for a time and gradually disappears inside the latter entering the same by making a passage through the ventral region. Gradually the caterpillar or if there are more, these caterpillars fix the host scale to the plant surface by means of the fastening described above. A fairly well-known caterpillar about to pupate measures 6·5 mm. In colour it is greyish green above, pale gray below, head and prothorax dark brown, and head almost black. A glistening hemispherical spot is found on each dorso-lateral side of the mesothoracic region dark in colour and enclosing a glistering space giving rise to one or two hairs. Similar but much smaller ones are found on the dorso-lateral region of the penultimate abdominal segment also. Spiracles are light brown and the body is fringed with short isolated transparent hairs. Two or three very faint longitudinal stripes are seen in some specimens along the dorsal region. Pupation takes place within a tubular closely woven silken coccon inside the host scale. Pupa is 6 mm. long, general form short and stout, colour reddish brown, wing sheaths and ventral region of a paler brown; there are two short dark spines at the posterior tip. The pupation period in some cases noted in captivity in November lasted 7 to 10 days. The moth is dark greyish-brown in colour. Each upper wing has a double transverse dark marking. The palpi are upturned and sickle shaped. Compared to the hinder ones, the first pair of legs are much smaller. While resting the moth has the head end raised and the hind end lowered, the wing tips touching the sitting surface. As far as the writer is aware this moth appears to be first recorded example of a lepidopterous insect living in association with the giant Coccidæ of the family Monophlebinæ, and the only recorded example of a Pyralid found in association with Coccidæ.

There is no doubt that many more cases of moths or butterflies with these curious habits might exist in different pairs of India and discovered in due course of time. As stated before this paper is just an attempt to invite the attention of entomological workers all over India to this aspect of insect bionomics—an aspect which is not only of biological interest to the pure scientist, but has its own economic importance and value.

THE BOMBAY NATURAL HISTORY SOCIETY'S INVESTIGATION INTO THE COMPOSITION OF SALT-LICKS

EARTH-EATING AND SALT-LICKING IN INDIA

BY

J. F. Caius, S.J., F.L.S.,

AND

K. H. Bharucha, B.A., B.SC.,
Pharmacological Laboratory, *Parel*, *Bombay*

Part I

Introduction

Geophagy or earth-eating is a matter on which much has been said and written. The subject has been much laboured but little advanced, unless we agree to use the term advance for the propounding of not less than half-a-dozen theories to explain this 'strange' habit.

'Earth-eating is a habit which overspreads all countries and breaks ethnological boundaries of every sort; it is found among the peoples of every continent, and apparently of almost every race. In this country it extends throughout the length and breadth of the land ; it is common on the boundary of Baluchistan, and is also found in Assam and Manipur near the North-East Frontier ; it is known and practised among the jungle tribes of Chota Nagpur and also by the high-caste Hindus of Bengal and the Muhammadans of the Punjab ; the Kolarian, Dravidian, Indo-Aryan, and Mongolian peoples, all indulge in the habit of earth-eating. This universal practice points to a deeper-seated cause for the habit than any ethnological or national distinction.'[1]

Earth-eating is indulged in by both the sexes, at any time of life, in all states and grades of society. Moreover, the purpose differs no less widely than the condition of the eaters as regards sex, age, or health before and after acquiring the habit. Earth is eaten as a delicacy, as a surrogate for confectionery, as a condiment, as a recognized article of food, as a medicine, as a tonic, as a charm, or as the result of imitation. Again, we find the most extraordinary variety of material used. Not only are clays, shales, and alluvial muds commonly taken; but, with the exception of sand, earth of almost every description is eaten.

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[1] 'Earth eating and the Earth-eating Habit in India,' by B. Hooper and H.H. Mann, *Memoirs of the Asiatic Society of Bengal*, vol. i, No. 12, 1906, pp. 249–270.

Earth-eating has been referred to as a strange habit, an unnatural habit. Strange, no doubt, when we consider man's usual bill of fare. Unnatural ? Surely not in the sense of contrary to the common laws of morality and decency. Is it then unnatural in the sense of a nutritional abnormality ? We do not think so. The purport of this inquiry is to show that this widespread craving for earth of some kind is the psychological expression of a physiological need, that the habit primarily rests on a physiological basis.

The notion of food is natural. It belongs to that common sense physiology which is transmitted from parent to child by heredity, and which the scientific fraternity find a difficult task to alter. We eat by instinct and habit, and it is instinct and habit which prescribe the menu. But whereas wild animals select their food naturally, the food of civilized man and of domestic animals is provided and prepared artificially.

It is generally admitted that an adequate diet must contain an adequate supply of the various inorganic substances which enter into the structure of the body. In contrast to the ' organic ' nutrients, which act primarily as carriers of energy, the mineral ingredients of food introduce no energy into the organism but do serve important purposes, both structural and functional, which we shall consider and discuss later when we bring this inquiry to a close.

The human body contains approximately : 2 per cent calcium, 1 per cent phosphorus, 0·35 per cent potassium, 0·25 per cent sulphur, 0·15 per cent sodium, 0·15 per cent chlorine, 0·05 per cent magnesium, 0·004 per cent iron, and very minute quantities of iodine, fluorine, and silicon.

The dietary adequacy of the last three elements is left to chance. Iodine, however, is an essential constituent of the thyroid gland and it seems probable, from recent investigations, that an adequate supply of iodine in the food is essential for the normal functioning of this gland. The presence of iodine is moreover inseparable from certain periods in a woman's life, and these are precisely the periods when in their case the earth-eating habit is contracted.

The sulphur requirement is met by the proteins—the nitrogenous compounds of food—of which it constitutes about 1 per cent. In practice, when the protein is adequate, the sulphur has not been found deficient.

If a reasonable amount of vegetable diet is used, the potassium requirement is fully met ; and the universal practice of using salt as a condiment insures a sufficient supply of both sodium and chlorine. Since salt is constantly being eliminated by the skin and kidneys it must be supplied by the food, and the reason for the addition of salt to potatoes and other vegetables is physiological as well as condimental.

The magnesium requirement has not been thoroughly studied ; but it seems to be adequately supplied by the mineral content of vegetables and meats, in many of which it is present in greater quantity than calcium.

The inorganic elements that are most likely to be deficient in a diet are calcium, phosphorus, and iron. We are inclined to attribute earth-eating among men and salt-licking among wild animals primarily to a deficiency in one or more of these elements. A superficial examination of the soils sought after by wild animals point to the fact that they are closely related to, if not the same as, the materials used by earth-eaters. And one thing which stands out prominently is that, whatever it is the wild animals seek in the salt-licks, it is not sodium chloride. What it is may be revealed by a careful analysis of numerous samples of soils from the tracts visited by them. This is to be the first step in our inquiry.

It will be seen that our percentages do not total a hundred. We want it to be understood that chemical analysis has not yet reached perfection. If for example, we were to analyse 100 grams of dry potato, we should find that the sum total of the constituents would amount to about 97 grams. It can be shown that the balance of 3 grams is not due to starch or some other known constituent having been lost in the process of isolation, but that it represents a quantity of unknown substances which the now accepted methods of chemical analysis are unable to separate.

As ours is a prolonged inquiry, we think we are justified in publishing occasionally the results of our work. We proffer them unreservedly to all who may be engaged in the study of the same problem, and we offer them gratefully to all who have assisted in collecting material.

ANALYSES

I. SOIL FROM SALT-LICK

SERIAL NO. 1.

LOCALITY—Maungmegan (Hot Spring), Tavoy Dt.
PROCURED BY—Mr. A. Brownlow, District Superintendent of Police, Tavoy.
SENT BY—Mr. W. S. Wood, Tavoy.

Heterogeneous mixture of earth, pebbles, fragments of quartz, fine sand, mica, orthoclase, hæmatite, cassiterite, and organic debris.

Minerals	49·80	per cent.
Sand	46·70	,,
Organic debris	2·29	,,
Humus	0·64	,,
Moisture	0·33	,,
Fine Earth (20 mesh sieve)	50·20	,,
Insoluble in nitric acid	46·480	,,
Lime (CaO)	0·100	,,
Tin oxide (SnO_2)	0·694	,,
Phoshorus (P_2O_5)	0·021	,,
Sulphur (SO_3)	0·065	,,
Ferric oxide (Fe_2O_3)	0·715	,,
Moisture and organic matter	1·556	,,

Remarks:—1. The soil contains traces of sodium, and carbon dioxide.
2. The lick is frequented by animals from the local forests.

II. Soil from Salt-lick

Serial No. 2.

Locality—Kaleinaung (Hot Spring), Tavoy Dt.
Procured by—Mr. A. Brownlow, District Superintendent of Police, Tavoy.
Sent by—Mr. W. S. Wood, Tavoy.

Ashy grey powder and pellets. Soft to the touch.

Clay	76·96	per cent.
Sand	17·79	,,
Organic debris	2·12	,,
Humus	0·60	,,
Moisture	0·30	,,

Fine Earth (20 mesh sieve)	99·28	,,
Insoluble in nitric acid	81·600	,,
Soda and Potash (Na_2O, K_2O)	0·200	,,
Magnesia (MgO)	0·085	,,
Lime (CaO)	0·215	,,
Phosphorus (P_2O_5)	0·026	,,
Sulphur (SO_3)	1·230	,,
Ferric oxide (Fe_2O_3)	3·600	,,
Moisture and organic matter	11·870	,,

Remarks:—1. The soil contains traces of aluminium, and about 2 per cent water-soluble organic matter.

2. The lick is frequented by animals from the local forests.

III. Soil from Salt-lick

Serial No. 3.

Locality—Sal Forests about 10 miles east of the town of Pilibhit.
Procured by—Mr. A. E. Osmaston.
Sent by—The Conservator, Working Plan Circle U. P., Naini Tal.

Pale yellowish brown powder and pellets with mica and organic debris. Gritty to the touch.

Clay	32·9	per cent.
Sand and mica	62·0	,,
Organic debris	0·4	,,
Moisture	2·2	,,

Fine Earth (20 mesh sieve)	97·19	,,
Insoluble in nitric acid	86·200	,,
Soda (Na_2O)	0·046	,,
Magnesia (MgO)	0·114	,,
Lime (CaO)	0·350	,,
Silica (SiO_2) soluble	3·253	,,
Phosphorus (P_2O_5)	0·027	,,
Chlorine (Cl)	0·074	,,
Manganese (Mn)	0·020	,,
Ferric oxide (Fe_2O_3)	3·750	,,
Moisture and organic matter	2·900	,,

Remarks:—1. The soil contains about 2·5 per cent water-soluble organic matter.

2. The lick is frequented by chital and sambar.

THE TOXICITY OF THE VENOM OF INDIAN SCORPIONS

Progress of the Society's Investigation

Since the publication of my last list on page 412 of this volume, the undermentioned quantities of poison have been collected by me from live specimens received through the co-operation of members and the Medical Departments of the various Provincial Governments.

	Number of scorpions	Weight of dry venom in milligrams.
Buthus pachyurus ...	2	5·2
,, *rugiscutis* ...	12	2·6
,, *tamulus* ...	70	122·7
Palamnæus fulvipes ...	2	8·7
,, *gravimanus* ...	4	14·6
,, *liurus* ...	19	12·5
,, *phipsoni* ..	9	42·5
,, *swammerdami* ...	17	244·2
,, *xanthopus* ...	3	12·4
Scorpiops asthenurus ...	5	5·6
,, *montanus* ...	5	2·4
Isometrus europæus (vesicles)	9	6·7

Pharmacological Laboratory,
Parel, Bombay.
March 18, 1929.

J. F. CAIUS, S. J.

REVIEWS

1. QUEER FISH. By C. M. Yonge, D.Sc., Ph.D., George Routledge & Sons, London, 1928. 5*s*.

2. BLUE BLOOD IN ANIMALS. By H. Munro Fox. George Routledge & Sons, London, 1928. 5*s*.

Issued with the 'Science for You' series, the purpose of these books is to acquaint the layman with various aspects of scientific discovery. Each volume consists of short readable essays on various problems which are attracting the attention of modern Biologists. The language is simple and therefore readily intelligible, hence, in spite of the highly technical and complicated nature of many of the subjects dealt with, these books charm, surprise, yet stretch the mind and increase their grip with every new reading.

In 'Queer Fish' Dr. Yonge deals mainly with various problems of Marine Biology. This is the special subject of the author who was the leader of the recent expedition to the Great Barrier Reef. The purpose of Marine Biology is 'the intensive exploitation of the seas for the benefit of mankind.' Dr. Yonge reveals the tremendous contribution which the Marine Biologist is making towards the improvement of the Fisheries of Europe and America. In addition to investigations into the structure, habits and development of marine animals his programme of research includes the study of diverse problems affecting the abundance and scarcity of fishes, their food, and the factors controlling their distribution. The temperature and salinity of the water, the extent and direction of ocean currents, the nature of the ocean bed and the deposits which cover it—all these have a direct bearing on marine animal and plant life. Of equal importance to the sea farmer is a knowledge of the vast multitude of animals and plants, mainly microscopic, which float or drift at, or very near the surface of the sea. This is the Plankton. Our knowledge of it is still very imperfect but there can be no doubt as to its vital importance in the economy of marine life. It is the prime source of food in the sea. Many diverse animals go to make up the Plankton. In addition to animals of all kinds there is a dense Flora consisting for the most part of microscopic plants known as Diatoms. Just as on land, marine animals depend for their food on plants, upon the number and distribution of Diatoms, which form one of the principal sources of food in the ocean, depends the abundance or scarcity of all other forms of marine animals, which either feed upon these minute plants or in turn become the food of animals larger than themselves. Data of this description, collected by Marine Biologists, is forming a mosaic of knowledge which is paving the way to the prosperity of those connected with the Fishing Industries. Nearly 70,000 men and boys are employed in the Fisheries of Great Britain. In 1925, nineteen and three-quarter million hundredweights of fish were landed which represented a value of nearly twenty million pounds. Two economists have attempted to estimate the total value of the fisheries in India. One estimates it at some crores, the other at only a few lakhs. Statistics recently compiled and issued by the Madras Fisheries Department are available. They deal only with a small portion of our coastline, a stretch of some 240 miles forming the seaboard of the districts of Malabar and South Kanara. An interesting fact brought to light is that the Malabar fishermen, fishing only within sight of their huts and using the most primitive types of boats and tackle, can catch as much fish as the Scotch fishermen, fishing along a wide belt of sea with the aid of the most up-to-date appliances. The conclusion drawn is that our Malabar waters are more productive than Scotch waters which are considered amongst the best fishing grounds in the world. Yet along the entire coast-line of India there is only one scientific organization actively concerned with the improvement of fisheries and that is the Madras Fisheries Department. The contribution in the matter of Marine Biological research of the Bombay Presidency, with over 1,000 miles of coast-line, as far as affects our fishing industry, is nil. Here we prefer to put exploitation before exploration—witness the abortive termination of our experiments with the steam trawler 'William Carrick.' To come back to our book, in addition to fishes both in and out of the water, Dr. Yonge deals with a variety of Marine products. Oysters, cockles, pearls and sponges all are considered, both on their own merits and from the point of view of the sea farmer. Other attractions offered are chapters on 'Growing Smaller', 'Regeneration in Animals' and 'Heredity and Environment.' One of the great advances of modern Biology has been the affording of definite proofs that schemes for social amelioration are not mere gropings in the dark, but have a definite biological justification. We cannot alter inherited factors but we can control environment and so order social conditions that the highest qualities latent in the constitution of a child may be able to develop.

Professor Munro Fox's 'Blue Blood in Animals' is planned on the same lines as the preceding work. The essays which make up the volume give a number of results of biological researches of to-day. The various processes and their partial solutions are lucidly described. Particularly interesting and of perennial interest are the chapters on 'Growth', 'Youth and Age' and the 'Control of Sex.'

What is it that decides whether a child shall be a boy or a girl? Shall we be able to control the sex of the offspring and decide whether a child shall be a boy or a girl? Several independent lines of research have convinced biologists that the sex of the offspring is usually determined at the moment of the fertilization of the egg by the sperm. A fundamental recent discovery bearing on the question is that we know now that in mammals, while the ova are alike, sperms are of two kinds. Fertilization of the egg by one type produces a male, fertilization by the second produces a female. With this knowledge of how sex is settled we are in a stronger position to attempt the control of the proportion of girls and boys born.

There is more than one method of attacking the problem. The more direct is to influence the activity of the sperms since it has been found by experiments with rabbits that one type of sperm is more susceptible to the influence of a drug, such as alcohol, than the other. In some such way, by using a drug which gives an advantage to one of two kinds of sperms it is conceivable that one kind of sperm might be made more successful in fertilizing eggs than the other kind. In this manner the desired sex might be produced at will. No attempt to do this has yet been made. Nevertheless we have taken a long step in advance in discovering exactly what is required to control sex proportions.

William Blake pleasantly classified those who took no interest in Art or Literature with the lower animals. To Arts and Literature he would now be induced to add Science. There is much truth in the dictum that Science, well taught, provides as much information and culture as the study of the humanities. These informative and fascinating volumes issued with the ' Science For You ' series are a convincing proof.

S.H.P.

3. TALES FROM SOME EASTERN JUNGLES. By K. W. S. Mitchell, author of ' Stalking Big Game with the Camera '. 276 pages, with 32 tinted photographic illustrations. Published on January 8, 1929. Cecil Palmer, London. Price, 15*s*. net.

This charmingly illustrated volume is descriptive of the jungles of Ceylon : and in its twenty-nine chapters the author introduces us to the jungle life of the country of which many of us have read in ' The Rifle and Hound in Ceylon ' by Sir Samuel Baker. There have also been other books dealing with the sport to be had in those dense forests.

Mr. Mitchell's book is on different lines. He is a lover of wild life, and one of those sportsmen, the number of whom is increasing, who prefer as a trophy, and record of hardly come by achievements, the photograph which records for the eye, facts and situations that were otherwise dead for ever in a moment.

Photographs of wild life by other authors are, as we know, very excellent ; but our author presents to us living pictures—photographs tinted by himself—which have about them a very special charm such as cannot be obtained by the printed photograph alone.

All who take up this book will agree with the author's remarks in the preface. 'Look at a photograph—it appears dead. A title only or a few words of explanation by word of mouth or pen—it lives. A touch of colour added, and the picture speaks as when it was taken, whether the subject was of still life or throbbing with vitality.' He asks the reader to judge how far he has succeeded, and the answer will be that nothing could be better.

In addition to the colouring which gives such reality to the pictures, there is with every photograph ample comment to explain it, how and where it was taken, and those small attendant circumstances the relation of which mean so much, and explain so much, to the reader.

Several of the tales have for their theme that unconscious heroism so often shown by the dwellers in jungle lands. Of these 'Greatheart' is a story relating how he so-named saved the life of the author when in pursuit of a dangerous man-killing elephant: 'A Jungle Hero' is a tale of the slaying, by one Kandatai, of a panther which had just killed his uncle and was on the corpse in the tropic moonlight; and of the wild beasts we have the somewhat incredible yarn of 'The Determined Mother' a panther, a tale related to the author by Jungle Wallah and dished to us to swallow if we will! Will we? The story of the brave stag sambur who 'For the love of a lady' drove off the panther which had seized his hind in the act of drinking at a forest pool, is true to life and no doubt related by the author on the basis of his own observation.

Why does Mr. Mitchell call. the females of the deer tribe, the sambur and the chital, 'does' and not 'hinds'?

Is the author correct in saying that the 'fang teeth,' as he terms them, of barking deer, mouse deer, and, we may add, musk deer, are possessed by these animals for tearing the bark off shrubs, etc. It may be so, but we do not recollect having read of that before. The hill man of the Lower Himalaya will tell one that these teeth are for piercing the skull of the panther when that blood-thirsty feline has the deer by the throat!

The autobiography of a spotted deer contains in this form the life history of a chital stag, and is well told.

The Rilowa is a yellow-brown monkey peculiar to Ceylon and we are told of the very unusual case of a monkey of another species attaching itself to a troop of Rilowas. It is not likely that the stranger was admitted by marriage into the community with which he was associated by some accidental circumstance during his adolescence.

In the chapter 'Jungle Cries and Curiosities' Mr. Mitchell talks of the 'Horror Bird', otherwise known as the 'Devil Bird', and is at a loss as to its identity. For many years the cry, which may be likened to that of a woman in mortal peril, was supposed to be made by one of the owls, and Blanford and Oates put it down to one of that species. Not long ago a correspondent from Ceylon contributed a note to the *Journal of the Bombay Natural History Society* clearly proving that this weird cry, so long a cause of surmise, is uttered by one of the night hawks; I have heard the cry in the jungles of the Jeypur Zemindari of the Vizagapatam District, but nowhere else in India. It would be interesting to learn its distribution and perhaps members will send in notes in regard to it.

The fact, recorded by the author, of a leopard devouring more than half the quills of a porcupine is most interesting. Most of us who shoot have found panthers, and tigers, to be on occasion well studded with porcupine quills, even—in the case of panthers—to the serious detriment of their health. But for a panther to swallow quills is indeed an extraordinary occurrence.

The tale of the pursuit to the death of a proclaimed wild buffalo is an exciting one. The conclusion that the buffalo is a crafty and courageous beast is a true epitaph for him.

At page 111 we are told that the timid wild creature of the day is quite a different beast at night. This is very true, and is brought to notice by several incidents. The sport of roaming about of a moonlight night in search of wild boars is shown to be not unattended by danger to the sportsman; and we have read in other sporting books of a similar pastime in the shooting, and even spearing, of bears by moonlight.

Talking of bears. The author does not, we hope, wish us to believe the yarn of Kyra waltzing with a male bear which took him being such a hairy man, for a female bear!

Also about bears he says that in all his experience he has never heard of a bear charging a light. There is no knowing what a sloth bear will, or will not do. Of his charging a light there are several recorded instances, one of which (early in 1917) was fatal to the sportsman returning from his machan after dark, with a lantern carried before him.

Of cobras, and the catching of them; also of the cure of a person bitten by a cobra by means of a snake-stone; the author relates an interesting tale. To the author 'seeing is believing', but in spite of his assurance the reader will be wise, should necessity occur, in trusting not to a snake-stone.

As to the common habit of unsporting people of shooting from motor vehicles, either by day or by night, the author has much righteous condemnation. There is not an atom of sport in such shooting which is, indeed, mere butchery. Mr. Mitchell also condemns the shooting of a tiger or a panther at night over a kill as 'butchery', but there we do not agree with him as the animal has all his wits about him and much technique of that class of sport and a considerable amount of endurance also is essential to success.

In the tale of a mad elephant there is much of interest to the reader. 'There was expectation in every moment.' That is the root cause of our pleasure in the jungle life in tropical forests. The foot note as to the sense of smell of the leopard for the following up of a blood trail, or the scenting of a high kill is in accordance with fact. The real danger of sitting up at night in forests where the wild elephant roams is well shown. The machan in such a case should be wholly out of elephant reach.

The relation of the tracking of an elephant will hold the reader's attention from start to finish; and he will wonder why the author did not enter the 'Sanctuary' to recover his well deserved trophy, as it is an established law that a wounded bird or beast may be pursued over the boundary whatever that may be.

At page 195 Mr. Mitchell questions the possibility of the shooter being able to hear the 'thud' of the bullet on its impact with the body of an animal. In the jungles of Ceylon, where animals are seldom shot at any thing over sixty, it is probable that the 'thud' would be not often heard; but in open country it is commonly heard, whether the rifle in use be one of low or of high velocity.

This very interesting book is an inducement to an unduly long review of it; there is so much to attract the attention. For instance, it is not all people who use the term 'survival of the fittest' as the law of the jungle, who realize that it is not only the physical fitness that is essential, but the mental fitness also. In such ways the author interests and teaches the reader all through the volume.

The closing chapter is explanatory of cameras and simple photography for the purpose of nature study, and will be useful to those who may be inspired by the beautiful results obtained by Mr. Mitchell to try and do likewise.

So we leave the book, confident in the unstinted praise that it will receive at the hands of the wide circle of readers to whom it will appeal.

R.B.

4. MISHI THE MAN-EATER, AND OTHER TALES OF BIG GAME.

By E. C. Stuart Baker, O.B.E., F.Z.S., F.L.S., M.B.O.U. 222 pages, frontispiece and three full page illustrations. H. F. & G. Witherby, London. 10*s*. nett.

All members of the Bombay Natural History Society are familiar with the valuable ornithological contributions of Mr. Stuart Baker, which have appeared in serial form in our Journal prior to publication as beautifully illustrated volumes for which the editors controlling our finances would wish a greater sale—and now we have from his pen a work of an entirely different kind—stories of big game gathered from fifteen years of shikar among the animals of the North Cachar Hills.

The experiences given to us are from the early days of the author's service in India—the days of the black powder express rifle—and but few of us have had the fortune to enjoy such grand opportunities of sport of all kinds.

The first hundred pages contain the tale of Mishi the Man-eater as related by himself, and a gruesome story it is. This Mishi, as he is now named, is the same monster whose initiation as a man-eater was described by the author in volume xxvii of this Journal.

Vividly does the narrative of Mishi enlighten the reader as to the upbringing of a young tiger, and the accidental killing of the first human being out of which, by degrees, grew the unnatural lust for the flesh of man, and man alone.

If there be any criticism to offer it is that perhaps Mishi is credited with a greater power of scent than a tiger ordinarily possesses. But that question is still a subject of controversy. If the analogy of the domestic cat be taken as a guide, then the tiger's power of scent is more than is generally supposed; yet it has been proved that tiger cubs, made to hunt for their food in the grass of the bungalow compound, have practically no sense of smell. Probably tigers, when obliged to become more than ordinarily cautious, do make greater effort to use such sense of smell as they possess, and we have several times observed their audible efforts in this direction.

Much does Mishi relate as to his upbringing and habits: his pace in pursuit of startled game; his manner of ham-stringing a ponderous bison or buffalo ; his lesson as to the danger incurred by killing an elephant calf; and a good deal more.

Then he recounts the heroism of some of the human beings he attacked. The brave mother who beat the ravening brute about the head and so rescued the lifeless corpse of her tiny baby ; the equally brave and aged parents of a son, slain by the striped scourge, whose mangled body they recovered ; and the gallant fight for his life put up by one of his victims. And there is the narrative of that night of horror when he three times raided a habitation, on each occasion extracting one of the four inmates, the last being the wife of an old man who bravely belaboured the monster's head with a burning brand in vain endeavour to save her life.

All this is most absorbing reading and, as Mr. Stuart Baker tells us, absolutely true in every detail. The reader can imagine for himself the intrepidity of the white man ' the wearer of a great round thing on the top of his head, quite unlike anything I had seen or heard of ', who, on many occasions, followed hot-foot in the fruitless endeavour of making Mishi pay the penalty of his career of crime. The tale is all absorbing.

The next twenty-four pages tell us how this white man, who is our author, at long last succeeded, and rid the country of this terrible scourge which had killed no less than fifty-two people in the short period of eight months. We take off our hat to Mr. Stuart Baker as a most intrepid sportsman.

Of buffaloes and pigs we are given some stories which contain much of shikar, and little of natural history, which is a pity as the author is a trained observer and must have a great store of interesting knowledge of the habits of the animals he knew so well.

So also in the case of bison and rhinoceros. Many most exciting incidents are related, including instances of resulting injuries and of narrow escapes—on one occasion even ' by the skin of his shin bone ' !—but we can with difficulty forgive Mr. Baker for not telling us more of the ways and habits of the fifty-four picked bison bulls which he laid low, and of the rhinos he came across so frequently. But perhaps he has much of this kind in store for us and we look forward to much enjoyment, and instruction, in the reading of it.

Of bears the author tells us something, but not all that he could relate. In common with all writers, he appears to accept the popular belief that bears mostly use their fore-paws, and the claws with which they are furnished, when attacking man. This we believe not to be the case, and remarked upon the subject in a former review (*Wild Animals in Central India*, vol. xxix, p. 1032) and a request for information on the subject was made in one of our Editorials, but without any result. Perhaps this opportunity of again mentioning the matter may have a better response.

The book under review is printed in large clear type. The proof-reading might have been more carefully carried out. The book will be widely read by the general public as a record of some of the experiences of a gallant sportsman, and by members of our Society with the hope that there is more to come.

R. B.

5. 'BEAUTIFUL FLOWERS OF KASHMIR'. By Ethelbert Blatter, S.J., Ph.D., F.L.S. Illustrated by Mrs. G. A. Wathen and Haldar Joo Walli, vol. ii (London 1929; John Bale, Sons and Danielsson, Ltd., pp. 204, frontispiece and pls. 34-62, Cloth. Octavo.)

In the *Beautiful Flowers of Kashmir*, vol. ii of which is the subject of the present review, Father Blatter has excelled himself. The book is popular in every respect. It is primarily intended as a guide to the uninitiated, and as such there is little left to be desired. Technical terms are as far as possible avoided, and the very few which could not be avoided are explained in a comprehensive glossary at the commencement of each volume. Further, in the present volume, at the request of many of those who used the first part of the work, the derivation and meaning of botanical names have been added thus enhancing the value of the book as a popular guide. But a guide, however popular and simple it may be, need not necessarily be so rudimentary in its presentation as to lose its scientific value and thus be of little use to the learned in Botany. Father Blatter's book belongs to this category. It is a book useful to the amateur, as much as it is of value to the advanced botanist.

The artistic composition of the book is excellent, and this is due chiefly to the carefully selected and beautifully executed illustrations in natural colour contributed by Mrs. Wathen and Mr. Haldar Joo Walli. The flowers depicted seem to breathe the freshness of the mountain air and are shown as realistic as they would appear in their native haunts. The feature of the illustrations is that the flowers are not shown as aggregations of calyx, corolla, stamens and pistil, but simply as flowers displaying wealth of form and glorious array of colour. Not all the flowers are illustrated, but those which are represent the most remarkable, most characteristic, and most commonly seen. To the dweller of the plains of India most of the species will be new, and a revelation as regards beauty of form and colour. The printed record conveys a very good idea of what is in store for those who are fortunate enough to visit the Happy Valley.

The book, therefore, will prove an invaluable guide to the tourist in Kashmir be he an amateur or a botanist of standing. Every lover of flowers should make it a point to provide himself with a copy.

J.F.R.D'A.

EDITORIAL

SURVEY OF THE EASTERN GHATS

The question of a Scientific Survey of the Eastern Ghats, which is for Indian Zoologists practically a virgin field, has been engaging the attention of the Society for a considerable number of years. It had been our intention to send collectors to this important area during the period we were undertaking our original Mammal Survey in the years 1911 to 1920. The main difficulties we were faced with were the unhealthy nature of the country which is, over its greater part, malaria-ridden, and the lack of transport facilities. Consideration of the question was however abandoned on the outbreak of the World War and the subsequent closing down of regular survey work. As regards malaria we can only trust in preventive measures—a good mosquito net, Wellington boots, and, according to taste, the application at sun down to all exposed parts of the body of either lemon grass oil or kerosine should, together with quinine, keep our men free from the scourge ; whilst as to transport difficulties—where there are roads there are now motor cars, and where there are no roads there is time !

There is no doubt that collections of mammals from the eastern provinces of India would be very valuable. A survey in this area would add greatly to what has already been done and would help to link up with the material and data obtained from the neighbouring provinces during the original Mammal Survey. Very little from the modern scientific point of view is known about the mammals and birds of this portion of the Indian region. A few sporadic notes have appeared in scientific publications, but so far no systematic effort has been made to study the mammal and bird life of the province. The absence of adequate and suitable material from so extensive an area leaves a considerable blank in our knowledge of the fauna of this country.

Early in 1928, the Society's Curator had the opportunity of discussing the question of a Survey of the Eastern Ghats with Mr. A. S. Vernay, the leader and organizer of various Natural History expeditions in India. At the end of the year, on his return to this country, Mr. Vernay requested the Honorary Secretary to put up a definite programme of the work it was proposed should be done. The outcome was that Mr. Vernay gave the Society £1,000 to cover the cost of maintaining a bird and a mammal collector in the field for the period of one year. Mr. Vernay is a Vice-Patron of the Society and one of its most generous benefactors, and we feel certain that members will join with us in thanking him for this practical demonstration of his interest in our Society. The collectors chosen for work in the field are Mr. V. S. LaPersonne and N. A. Baptista. Mr. LaPersonne has had considerable experience as a collector on various expeditions in Mesopotamia, Persia, Baluchistan and the Trans-Himalayas. Baptista was for many years with the Mammal Survey where he was trained in field work by Mr. Crump, one of our most successful collectors. He was subsequently sent on several expeditions, notably the Roosevelt and Vernay-Faunthorpe expeditions, and carried out very successful survey work in Nepal. The present survey is concerned not only with mammals and birds but is to be extended to include general zoological collecting. In this connection we are glad to announce that the Indian Museum authorities are co-operating with the Society and are sending parties to join our collectors in the field. This will considerably enhance the scope and the value of the work.

Our collectors commenced work in the Salem District in April this year. As at present planned, the party will work gradually northwards through the districts of Cuddapah, Kurnool, Godaveri, Vizagapatam, Ganjam, Balasore. Collections will be made at various elevations in the main range of the Eastern Ghats and in its immediate spurs and also in the adjoining plains.

COLLECTING IN OTHER DISTRICTS

Mr. J. K. Stanford, Deputy Commissioner, Prome, has employed one of the Society's assistants in making a collection of the birds of Prome from January 9th to April 20th of this year and we are very grateful to him. We have not always collectors available but we are always glad to hear from any member who thinks he could look after a collector for us whilst the member is on tour in favourable zoological districts.

FORTHCOMING VOLUMES IN THE FAUNA OF BRITISH INDIA SERIES

Mr. Malcolm Smith, who is responsible for the revised edition on Reptiles and Amphibians in the above series, advises us that the work will be issued in 3 volumes :

I. Crocodiles, Chelonians and Lizards.
II. Snakes.
III. Amphibians.

The scope will be much as in the original volume but more attention will be paid to general bionomics and to general introductory details, so as to make it a little easier for the beginner to understand.

He tells us that two of the greatest wants in the British Museum are ; (1) good series of the small tree-frogs *Rhacophorus* and *Ixalus* from the hills ; they are best caught at night by going out with a lantern and tracking them down when they call ; and (2) good series of the tadpoles of all Amphibians. These *must* include fully developed individuals showing all four legs, that is to say some that are sufficiently advanced to enable them to be identified. They are best preserved in 3 or 4 per cent formalin.

Mr. Malcolm Smith also complains of paucity of material in the genus *Kachuga* (fresh water turtles) and particularly wants spirit specimens, as practically nothing has been added to the British Museum collection since Boulenger's Catalogue in 1889. He does not require shells of the big *Kachuga trivittata*, but would welcome anything else. Will members help by sending us any tortoises and turtles (except marine turtles) they can procure from India and Burma ? The difficulty in preserving these bulky creatures can be overcome by putting the head, limbs and tail in spirit, and preserving the shell dry, making sure of course that corresponding numbers are given to avoid confusion.

Many problems await solution. One is what is the Mugger of Burma ? Is it the Indian one *C. palustris*, or is it *C. siamensis* ? Specimens of Burmese crocodiles are wanted. The skull or a piece of the skin from the back will be sufficient.

THE SOCIETY'S JOURNAL

The present issue is rather an abnormal one and whilst the Committee hope it will be helpful as a good advertising number, it must not be considered as a typical issue even when being used as a lever to obtain new members.

The publication of Mr. Pocock's paper on Tigers (How are the mighty fallen ! who would have imagined that the tiger would have given pride of place to the panther as head of the family !) has been delayed longer than we care to think of and though somewhat lengthy is hardly suitable for division into two parts. The illustrated article—the first of a series—on the Conspicuous Flowering Trees of India was planned many many years ago. We think it really originated with Mr. H. M. Phipson who worked up a wonderful collection of illustrations of the flowering trees and shrubs of India. Certain it is, however, that before Mr. W. S. Millard left India he had had painted by various artists numerous illustrations of our flowering trees which he knew would be of use should he ever be able to get a really popular illustrated book on the subject published. His forethought has been of great assistance to the Society as we have not had to pay for the painting of the pictures. Have we succeeded even now in getting a 'popular' paper written ? Time will show but what we have tried to do is to publish a description of trees which the ordinary man in the street will be able to understand. If we have succeeded the present Journal will be an excellent recruiting agent.

PUBLICATION OF THE THIRD VOLUME OF THE GAME BIRDS OF INDIA SERIES. PHEASANTS, JUNGLE FOWL AND SPUR FOWL

We are instructed by the Committee to advise that publication of the third volume of Stuart Baker's Game Bird series has been sanctioned and orders have been sent home for the printing of the book.

Orders have up to now been booked on the assumption that the published price would be £3-10-0 and that members not possessing either of the two previous volumes would pay Rs. 40; that those possessing one copy of the previous volumes would pay £2-10-0 or

Rs. 33-5-0 ; and that those members possessing both volumes would pay £2 or Rs. 26-10-0.

On the above terms we have registered orders for 133 copies.

We have now pleasure in advising that it has been decided to reduce the published price to £3, or to members to £2-10-0, and to reduce the price to members who possess one of the previous volumes to £2 and to those members who possess both to £1-5-0. All orders already booked will be executed at these reduced rates.

It is admitted that the reduction has been made to increase the sale of the first two volumes.

The members' price of the first volume (Ducks) is Rs. 35, of the second (Woodcock, Snipe, Bustard and Sandgrouse) Rs. 30.

A member not already in possession of any of the volumes and particularly wanting all three will, by purchasing the third volume, have (so to speak) £1-5-0 (say Rs. 16-12-0) in hand towards the purchase of the first two which will thus only cost him for the pair of books Rs. 48, and yet the benefit he gets is little compared to the benefit the non- member gets who joins the society and buys all three volumes.

Readers will miss in the present issue, the third part of Mr. Hugh Whistler's serial on 'The Study of Indian Birds'. The author writes to say that due to his recent collecting expedition to Kashmir and Gilgit and to the work entailed on the collections, he has not been able to settle down to this paper. We are glad to hear however, that the thread will be taken up again in our September number.

Finance

The Honorary Treasurer has prepared his budget for 1929–1930. It has been a difficult matter as we are not getting as many new members as we ought to. Without an ever-increasing membership we cannot bring out four Journals in a year and there is a deal of difference between three Journals brought out at four monthly intervals and four Journals brought out at three monthly intervals. The difference is not merely in cost but also in the interest taken in the Society.

Museum

We are still lacking a lakh.

BLACK PANTHERS—AN INQUIRY

To owners of Zoological Gardens and to dealers in wild animals it is well known that black panthers, which command a much higher price than the normally coloured specimens, are almost invariably exported from the Malay Peninsula where, according to Mr. Boden Kloss, they replace the ordinary type to the South of Malacca. They are found too, in Java and Burma and a few years ago a specimen from Assam was exhibited in the Gardens in Regent's Park, London. In Hodgson's collection in the British Museum there are also skins from Nepal, and Blanford declares this variety to be commoner in the hills of Southern India and in Travancore than elsewhere in the Peninsula.

The purpose of this note is to procure from sportsmen information regarding the black panthers from Southern India. This may seem a superfluous inquiry. My reason for making it is this. Blackness in panthers is brought about by two different processes. In the commonest type it results from the development of dark pigment, or melanin, in the hairs which are normally orange or white. The spots themselves, apart from their centres which are dark, remain unaffected and show up clearly in certain lights owing to their greater glossiness. On the belly they are usually better defined because the melanin added to this white area is commonly dark rusty brown and therefore paler than the jet black spots. These panthers are typical ' melanos ', and in my experience this kind of black panther, and no other, is the form that commonly occurs to the East of the Bay of Bengal. In the second case the blackness may be described as due to the breaking up and coalescence of the spots and their encroachment over the orange interspaces so as to obliterate them to a greater or lesser extent. Panthers exhibiting this peculiarity were recorded long ago from Grahamstown in South Africa. But they were not known, so far as I am aware, from India until 1927 when Mrs. C. A. Souter sent to the Natural History Museum a flat skin of one which was killed at Kanara and secured by her husband who told me the native who shot the beast had some difficulty in getting his due reward because the identity of the animal was disputed owing to its dissimilarity to the panther with which the authorities were familiar ! I described this skin in the *Proceedings of the Zoological Society* for 1927 as having ' the rosettes broken up and fused to such an extent that, supplemented with additional pigment, they convey the impression of a blackish animal speckled and streaked with yellow.' The interspaces, indeed, are so reduced in extent that they are represented mainly by narrow lines, straightish or zig-zag or shaped like forked lightning. This very peculiar variety, in which the belly is normally white whereas the body is mostly black, is not a true ' melano '. Nevertheless it might, with a little latitude, be described as a black panther ; and it would be particularly interesting to know if the black panther of Travancore and other parts of South India mentioned by Blanford belongs to this or to the ordinary type of black panther. In vol. xvii of this *Journal*, for instance, Lieut. Col. W. B. Ferris referred to a black panther from Kanara, where Mrs. Souter's specimen was killed; but he gave no particulars to help to a conclusion on this point, although it seems certain that his example, if of the same type as Mrs. Souter's, retained none of the yellow specks and streaks or the white belly of that variety.

Information regarding the question here raised would be especially welcome in view of the forthcoming publication of a new and enlarged edition of the 'Mammals of British India.'

BRITISH MUSEUM, (NATURAL
HISTORY),
SOUTH KENSINGTON,
LONDON, S.W.
February, 1929

R. I. POCOCK, F.R.S.

MISCELLANEOUS NOTES

I.—THE SENSE OF SMELL IN INDIAN *FELIDÆ*

With regard to the controversy that is going on in the *Field* as to whether Tiger, Panther and Lion, rely on their sense of smell or vision when hunting, I am interested to find that Sir John H. Parsons, the eminent ophthalmologist, and R.R.S., in his *Introduction to the Theory of Perception* says, 'In the dog smell is the dominant factor, in the cat vision.' In the same work the author remarks on the acute sense of vision the cat has as regards moving objects, but poor for stationary objects. Most sportsmen I think will agree that this applies equally to tiger and panther.

HONNAMETTI ESTATE,
ATTIKAN P.O.
Via MYSORE,
(S. INDIA).
December 8, *1929*.

RALPH C. MORRIS.

[The concensus of opinion of competent Indian sportsmen and naturalists seems to point to the a cuteness of eyesight in the tiger and panther, and, unlike the African lion, to a corresponding dullness of their sense of smell. Moreover, there also seems general agreement on the point that although these animals hunt almost entirely by sight, they are singularly indifferent to objects, often quite conspicuously coloured, unless some movement, be it ever so slight, is manifest in them. EDS.]

II.—A WOUNDED SAMBHUR SEIZED BY A TIGER

I had wounded quite a good stag late in the afternoon of the 21st of this month, on the top of which it came on to pour with rain thus making it later still before I could follow up, so the shikari and I merely entered the jungle where the stag went in. In this very piece by the way I had heard Langur monkeys clamouring, which often indicates a tiger or panther on the prowl. We soon found blood tracks and, shortly after the stag broke away, having lain down quite close. While we were discussing the wisdom of taking up the tracks next morning, we suddenly heard a great outcry from what was evidently my stag, so much so that I suggested to my tracker a tiger might have seized the wounded brute, but my Sholaga would not accept this theory and as it was getting dusk we retraced our steps.

Next morning the shikari Kerta and I started off, on what meant a big climb of 1,000 ft. to the hill-top. The sambhur had plunged down-hill in dense jungle and we were nearing where we reckoned the stag had cried out, when Kerta, whom I had warned to stop every few yards to look well ahead, pointed out a light coloured object lying down in the *Strobolanthi.* Getting out my field-glasses, I was surprised to see a huge tiger, stretched out on its side, having a siesta after its night's feed, having seized the oncoming sambhur. Its position was such that it could not possibly see me, its back being turned my way, so using the greatest of caution, we stalked it to within 40 yards, when taking advantage of a sapling to steady my gun on, a Westley Richards 12-bore Explora, I put a bullet plum in the centre of the back of the tiger's neck, just behind the ears. He never stirred except for a slight twitching of the ears, and I thus bagged two trophies as the stag's horns were beautifully beaded, having just lost its velvet, and the tiger was a splendid male specimen.

CHAS. W. G. MORRIS.

'Garstead'
Attikan, P. O.,
Mysore State,
October 29, 1928.

III.—DECOYING TIGER BY SOUND

I give below a true account of an experience that I had with a tiger a few months ago and am anxious to know if anyone else has had a similar experience.

'On the evening of July 19, a couple of tigers had been frightening the ponies by calling and snarling in a small ravine that is just behind the stables and bungalow and it was only due to the servants making a row that they did not come out to attack them. I came home about 8 o'clock and, as they were still arguing, fired a shot to scare them. I heard nothing further till 3.30 a.m., when one of them called rather near the stables, so I flashed a torch to see if I could locate the brute, but he was a bit too shy as he went back into the jungle before I could view him.

The next night at 9 o'clock I heard one of them 'oughing' (calling) on the main road which is about 300 yards in front of the bunglow, so I started imitating it and after a few calls had passed between us, I found that the animal was coming closer. It passed the stables and called again near the ravine and as it was still answering me I kept up the imitation.

While it was passing the stables I moved to the corner of the verandah and when it stopped calling I kept quiet and after a minute or so's silence I heard a slight rustle in the tea in front of me. I put on the torch and saw Stripes a few yards away just as he was getting on to the road leading to the stables, so I immediately drew a bead on his head. He received the bullet a bit low as it hit the centre of his nose and travelled down his throat; most likely injuring his vocal chords, as he staggered away without a sound. He was facing me when shot but the shock threw him back and he was facing the stables when staggering off. He fell into a drain and as I could not make him out clearly, I waited until he came out and then gave him another behind the shoulder. He staggered another few yards and fell and all I could see were his hind quarters and tail which was still twitching.

I waited half an hour and seeing no movement went up to him. I wanted to bring him into the bunglow but my Chowkidar was averse to soiling his hands and was too frightened to help so I had perforce to leave him there. I took his measurements next morning and found him 9 feet between pegs. The animal was exactly 14 yards away from me when he received the first bullet and the marks of his pugs were distinctly to be seen, where he had walked up and where he jerked with the shock. I noticed when the animal was calling that there were two distinct calls. One was the usual 'Aough' with the 'Ugh' very deep and drawn out, and the other sounded exactly like an Indian saying 'Aw' (come). I should like to know if any one has ever had a like experience as I have heard of deer being called up but never tiger. The weapon I used was a ·470 Hammerless D. B. H. V.

THE CHUBWA TEA COMPANY, LIMITED. M. O. DALY.
KELLYDEN DIVISION.
October 7, 1928.

[We have known tigers in Burma to be attracted by the peculiar bleating noise produced by blowing over a tender leaf held edgewise between the palms of the hands. This dodge is commonly employed by the Burman pot-hunter for calling up Barking Deer and Sambar to be shot, and when a tiger is anywhere in the neighbourhood it not infrequently happens that he puts in an appearance instead, much to the embarrassment of the ambushed hunter!

It is probably nothing but curiosity that attracts animals to this noise, as it is certainly very different from the call of any of the species attracted by it. EDS.]

IV.—ARE THERE MORE THAN ONE SPECIES OF PANTHER IN INDIA?

Articles recently appearing in the *Field re.* Pigmy Panther in Somaliland have interested me, especially in view of the fact that I am not sure we have not a similiar case in India. While on the Nelliampathy Hills (Malabar) in 1919 I shot a small very dark panther which struck me at once as being a pigmy of its species. The panther was first seen lying on a rock and it looked so dark that I took it to be a black panther which was not the case however. On killing the animal I found to my surprise that, although only about 5′ long it was old as its teeth clearly showed. As already stated, the skin was very dark and the rosettes and spots very close together. The local trackers declared that it was one of a species of panther that preys on the Ibex (Nilgiri Tahr) on the cliffs there, and this is quite possible as I actually shot it on a rock on the summit of a cliff, and a herd of Ibex was at the time grazing below. I later learnt that the late Mr. A. M. Kinloch had shot two panthers of the same species very similar to the one I shot, both of which had taken to trees having been chased by his dogs. I regret that I have mislaid the measurements of the panther taken at the time, but I have of course in my possession the mounted head and skin. At first glance the head can easily be mistaken for that of a half grown ordinary panther except that it is very dark. Apart from this species, the ordinary type of large panther are to be found on the Nelliampathis, including a fair number of black panther.

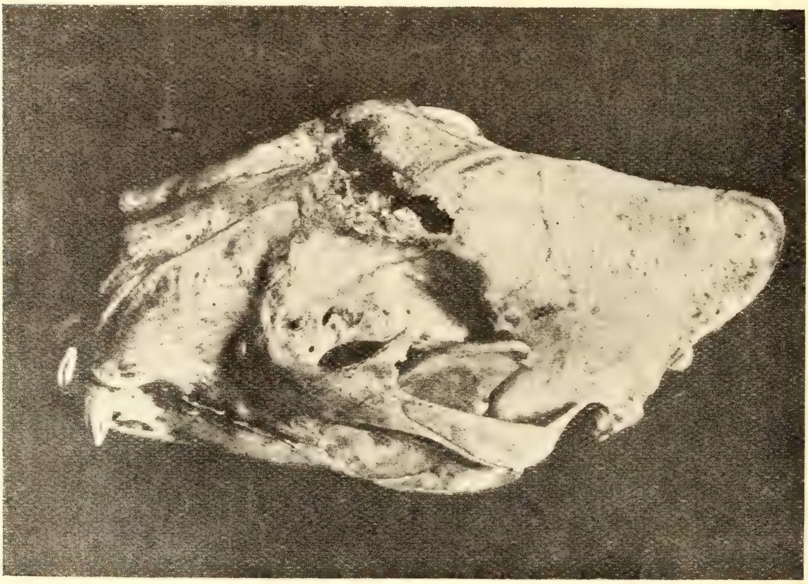
HONNAMETTI ESTATE,
ATTIKAN P.O.,
Via MYSORE, S. INDIA.
12th January, 1929.

RALPH C. MORRIS.

V.—VITALITY OF A PANTHER

(*With a photo.*)

Whilst shooting last January on the Nepal border in the Gond (*Rucervus duvaucelli*) preserves of the Maharani of Khairigarh with Kunwar Dillipat Shah and the Maharaj Kumar of Bikanir, an interesting episode occurred. The Maharaj Kumar and we had been beating for Gond all day and in the evening shot a fine 36½ inches Gond stag, 15 points. We were consequently somewhat delayed in getting to the motors to take us back to camp, and after going approximately a mile through thick jungle on one side and thatching grass on the other, we saw, by the head-lights, a



large leopard lying across the road. He was seen about 50 yards away. He got up in a leisurely manner and walked slowly into the thatching grass, and we thought disappeared inside. However, we approached carefully turning on the spot-light and coming up to the place where the leopard had gone in we saw him exactly 5 paces away. The Maharaj Kumar fired killing the animal, a very fine leopard of 7 ft. 8½ inch. On skinning him it was found that he had been previously wounded in the skull (see illustration) although there was no sign of this in the head-skin. It seems inconceivable that any animal could withstand a wound of this kind without being killed. He had been shot at and wounded by a solid bullet probably from something around ·375 bore.

It is interesting to note that inspite of having previously been wounded he should stand at 5 yards (the distance was measured as he fell in his tracks) without showing any alarm at all.

Bombay, A. S. VERNAY.
March 13, 1929.

[An examination of the skull in the photograph showed that the bullet had entered above and behind the left eye completely destroying the post orbital process of the frontal bone. It had then passed obliquely across the top of the skull, through and across the base of the frontal bone, raking a furrow 2¼ inch in length and ¾ inch at its broadest. The bullet had come out above the right eye also smashing the frontal bone down into the eye-socket for 1¾ inches by ¼ inch at its broadest. The lower part of this fracture was completely healed by a callosity forming over it for ⅞ inch from the base. Eds.]

VI.—A RECORD PANTHER

I note that some doubt has been cast on the identification of the skull that I sent you in 1921 (See paper on *Tigers* by R. I. Pocock, p. 518 of this number. Eds.) In March 1921, when I shot the beast I had no idea it was a ' record ', as I only learnt this later, on receiving your letter, with measurements, etc. I have shot many large panther and tiger, and have shikared for 29 years, in India, South and East Africa, so though it looks boastful for me to mention this fact, the person who doubts as to whether I know the difference between ' Spots and Stripes,' must give a little credit for my knowledge on shikar.

The panther in question, was seen by me several times, also by Col. W. Ward. He saw it about 15/20 yards away, (two miles from here) and told me, it was the largest panther he had ever seen and he has shot very many.

My attention was attracted to the beast, by hearing the ' sawing ' call of panther, which is very different from any noise made by tiger.

If the light had been better, (to see my foresight clearly) I would have obtained a finer shot, but, the panther saw me raise the rifle, jumped aside and I could only get a snap at him, going downhill, still it was easy to see the spots on him, note his crouching and cunning, his call, (like 'sawing wood', as mentioned) and the quick way he spotted me and jumped, which is very different from the habits of tiger. Most tiger I have seen out stalking don't display cunning and, when seen, do not crouch or jump aside.

Pieces of skin that I found with the entire skeleton were dark, not an inch of fur without black, this proved it to be the panther, as the ground fur was yellow, and not tawny or orange-red, like a tiger's coat.

I told Mr. Van Ingen this and said I was positive that the animal I had shot was a panther. At this time Mr. Van Ingen was very young, and has rather mixed his remarks in his letter to your Society, so to make quite sure I sent the skull to his uncle, Mr. E. M. Van Ingen, the noted shikaree and taxidermist (who died last year). He carefully examined the skull and in his reply dated October 29, 1921, says:—'Of course the skull belongs to a panther'. Mr. E. M. Van Ingen of Mysore in the last half century probably had serveral thousand tiger, panther, and other animals pass through his hands; is it likely he would make a serious mistake also?

Clavicles of my record (adult) panther are 2½″ × ¼″, my best tiger 3½ × ⅞″.

E. LIMOUZIN.

Dunsandle Tea Estate,
Ootacamund,
Nilgiri Hills,
February 14, 1929.

VII.—ON THE OCCURRENCE OF THE CHEETAH (*ACONONYX JUBATUS*) IN IRAQ.

(*With a photo.*)

In the pamphlet on Mesopotamian animals issued by the Society in 1916 a note states that 'the cheetah may occur in Upper Mesopotamia as it is still found in Asia Minor, Syria and perhaps Palestine.'

In 1925 a cheetah cub was secured at Jumaimah, Muntafiq, Iraq, by a member of the Dahamshah tribe and brought in and presented to Mr. G. C. Kitching of the Ministry of Interior.

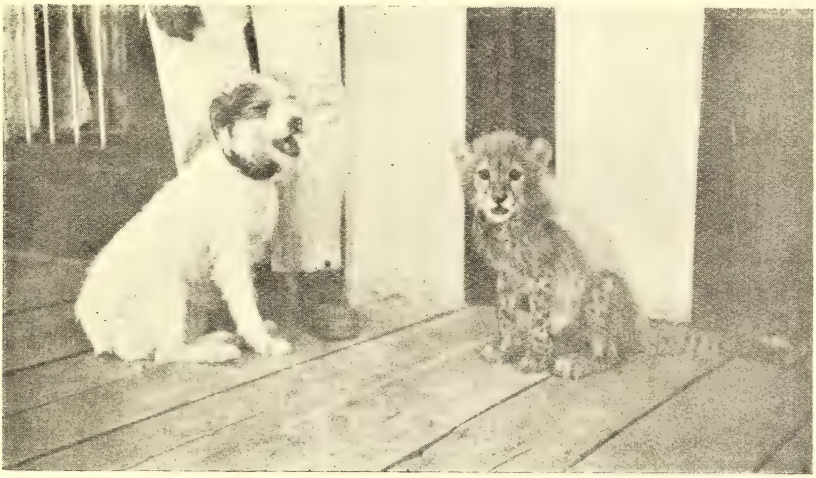
It is said to have been identified and placed on record by Sir Percy Cox. It was said to be about three weeks old, was fed on milk and died after three weeks' captivity.

In July 1927 Nahaita, an Araif tribesman and professional desert hunter, reported to Captain C. E. Corry, Inspecting Officer of Police, Nasiriyah, that he had seen a leopard (*fahad*) in a ' wadi ' near Busiya. We visited the ' wadi ' and Captain Corry remarked that certain tracks were like those of a panther. We spent three hours in a vain effort to locate the animal.

In July 1928 the same hunter reported the same occurrence in the same wadi.

He was told to fetch in the skin but returned better still with two cubs. He had followed tracks to an old well, thrown a stone down, and after hearing a whimpering, the mother having flashed out and away, had climbed down and found the two youngsters.

The cub in my possession is a female and probably about two months old. It is thriving, playful, and even affectionate. It plays amicably with dogs.



THE CHEETAH CUB FROM BUSIYA.

The fur on the back is fawn, quite long, being two and a half to three inches, and unspotted. Belly and limbs are tawny and spotted black. The spots on the tail towards its extremity become rings. The legs are relatively long and the claws are semi-retractile. The tail is more than half the lengh of the body. The ears are relatively large, roundish and black exteriorly ; they are very mobile and are constantly being moved. The head is broad, round and high, the tear ducts being defined.

It tumbles and springs about clumsily when free, eternally stalking playfully a small terrier upon whom it leaps from behind chairs, tops of tables, etc. It is very restless when tied up and purrs intensively when I go to release it.

It sleeps at night lying fully out-stretched.

As regards diet, milk, cooked liver, meat, and rice seem to suit it perfectly.

It was taken between Abu Ghar and Busiya on the Shamiyah Desert, S. W. of a sand-belt that teems with wild-life.

This region is about Lat. N. 30° 40′, Long, E. 45° 45′ and altitude about 100 metres. Many old disused wells are scattered about, and I know of at least one perennial pool further north. Gazelle abound, so do hare. The place Jumaimah referred to above may be considered in the same region. The 'wadis' here are thickly covered in places with vegetation, even 'nebuk' trees occurring.

Captain Corry very kindly gave this cub to me. Its fellow is also in Baghdad in the possession of an Iraqi Army Officer.

The local Arabs are as surprised as we. They have no special name for it, merely speaking as they do of a 'fahad' i.e. leopard; even so their talk has a legendary ring, none of them having seen one before.

One wonders if after all the Babylonian lion is really extinct. There are still in Iraq many regions virgin to man's recording.

NORMAN L. CORKILL,

ROYAL COLLEGE OF MEDICINE, BAGHDAD,
August 21, 1928.

VIII.—A BROWN VARIETY OF THE SLOTH BEAR *(MELURSUS URSINUS)*

I enclose a photograph of the skin of a sloth bear shot by me some years ago in these Provinces. The colour is a light golden brown and the hair is particularly long and thick. It was accompanied in the beat by three ordinary black sloth bears and two leopards. It was an average sized male. I have never seen another of this colour, but have heard people assert there are other known specimens of a similiar colour.

RAJPUR, C. P.
September 4, 1928.

J. A. DUKE,
I.P.S.

[Several instances are on record of a similar variation in the colour of the Sloth Bear, which, as suggested by us on a previous occasion, may be brought about through the action of the physiological condition known as erythrism or of partial albinism. The brown and isabelline forms of our common Indian House Crow, not uncommonly met with, are also due to the same causes.

A Sloth Bear of the brown colour variety is reported from the Hazaribagh jungles on p. 145, vol. xxiii of the Society's Journal, while earlier, a correspondent writing in the defunct sporting paper, *Asian*, of March 9, 1886, gives an account of his killing a Sloth Bear with 2 cubs, one of which was brown instead of the usual jet black.

Mr. Duke's photograph of the skin is unfortunately not suitable for reproduction. EDS.].

IX—ON THE HIMALAYAN PALM-CIVET

(PARADOXURUS GRAYI)

Some days ago I had occasion to place a trayful of ripe and semi-ripe tomatoes on a wall in front of my house. The following morning I found that the tomatoes had been raided by some unknown animal, most of the ripe fruit had been eaten, and the unripe lay strewn about. Altogether about 50 fruits had been eaten, and it appeared clear that more than one animal had been implicated in the theft. Various suggestions were made by my orchard staff and servants, which included rats, porcupines, pine martens and foxes; but on the arrival of my head gardener, an experienced man, he at once declared it to be the work of a pair of *Kerodes*—the local name for the hill civet. This proved to be correct, as the next morning one was caught in a cage trap baited with ripe tomatoes. This was a female, and this morning a second was secured which proved to be a male, no doubt the first one's mate.

The colouration of the animals agrees with that given on p. 113 of the *Fauna of British India.* In the intermingled black and white hairs on the face of the female, white predominates and forms a white pattern down the face from the top of the forehead and nearly down to the nose and under the eyes; whereas the head of the male presents a more grizzled appearance, the dark hairs predominating. The vibrissæ of the male are all white while in the female the upper two are black. The male is altogether darker than the female.

When first caught and occasionally since, the female gives vent to a curious staccato noise, something between a snort and a sneeze, made no doubt to intimidate the observer. A curious point which I observed in both sexes is the movements of the vibrissæ; one moment they appear to be projected forward longitudinally with the line of the mouth, and the next moment are switched back close to the cheeks, giving the impression that the vibrissæ are extremely sensitive; for instance they always touch an apple when presented to them with the end of the vibrissæ. Another curious habit observed is the way in which they eat fruit. The female when given a small apple takes it up in her fore paws, sits on her haunches and eats it in exactly the same way as a squirrel does, giving one the impression of a gigantic squirrel eating a nut. If the apple is a large one it puts it on the floor of the cage between its fore paws and eats it in the same way as a dog does a bone. I daresay the male will act in the same way when we become more intimate.

I can readily believe that this animal is easily tamed. Although caught less than a fortnight ago, she comes to the bars of her cage, and takes pieces of apple from my hand never attempting to bite my fingers, and altogether appears to be a gentle creature.

BINSAR ESTATE,
Via ALMORA, U.P.

S. J. MARTIN.

X.—HOW WILD DOGS KILL THEIR PREY

In Miscellaneous Note No. XI of volume xxxii, page 591, a correspondent denies that wild dogs are in the habit of emasculating the prey attacked. I had a very curious experience in Java where I saw a pack of five native trained pariah-dogs kill a big boar. Having seen how they did it, I think it more than likely that wild dogs follow similar tactics. In that particular part of Java there are few wild dogs left and I have never seen them there nor their kill, but the native fox-red pariah-dog 'gladak' is said to have been bred from them, possibly crossed with jackal.

When in Sourabaia in 1910–11 I used to go south to Lawang for week-ends for pig-shooting in the forests on the eastern slope of the Tenger mountain ridge. I used to get trackers from a village there and the 'loerah' (headman) having on various occasions greatly assisted me, I made him a present of a hundred cartridge-cases, powder, caps, wads, shot, bullets and the necessary implements for making his own cartridges for his 12 bore-gun. I am afraid I broke a whole lot of laws in doing so, but I made a friend for life. To show his gratitude he promised me a treat on my next visit. The treat proved to be a boar hunt with his pack of dogs.

He had five native pariah dogs, fox-red but scanty of hair, in patches practically naked, stiff-eared and about 2 feet high at the shoulder; awful, cringing, slinking, sneaky curs when alone but real devils when in a pack after prey.

We started at sunrise. The loerah, his son and I had 12-bore guns, to be used only in case of tiger or panther. Each dog was led on a leash by a native armed with a serviceable 'parang' (chopper). We followed the path through the jungle until tracks had been found near the older forest; the natives and dogs halted and the loerah, his son and I went on for another quarter mile until we came to old forest with little undergrowth. The game was driven towards us and a big boar came out with the five dogs behind and beside him.

The dogs never tried to bring the boar to bay as long as they were in thick jungle or 'lallang' (*Imperata* sp.), but once they had him on comparatively open ground in the old forest they closed in. The boar sought refuge between two buttress roots of a big forest tree and was kept at bay there, and then the fun began. For more than a quarter of an hour the dogs baited him furiously in order to tire him out and then suddenly came the dramatic finish.

The leader of the pack who was in the centre apparently commanded silence with two highpitched sharp barks: *ki-ki.* Silence fell. The two sharp barks were repeated and both the dogs on the extreme flanks replied with three sharp barks: *ki-yi-yi.* The next moment the leader in the centre made a feint at the boar and drew him out for about a foot and a half. The boar tried to gore the dog by a mighty upward sweep of his head, half turning to the left, but missed him by half an inch. At the same moment the dog on his right, at the end of the pack, leapt at his right flank that was exposed for half a second. In his leap the dog bit the boar's right ear and, keeping a good grip on it, slung his whole body across the boar's neck. Next moment the three dogs in the centre got busy, going for him *in turns* and never giving him a chance of getting at the dog across his neck; the moment his left flank was exposed, the fifth dog on his extreme left, sneaked in like lightning between the root buttress and the boar that had been enticed out partly, got behind him, snapped at and made one mouthful of the boar's testicles and was out at the other side like a flash. Twenty seconds later that boar was lying on his back with throat and belly ripped open and yards of intestines all over the place; the fight was over and none of the dogs had been seriously injured.

It was beautiful teamwork and the signals given had been as clear as bugle-calls and showed perfect understanding between the five dogs. The natives said that near the finish of the preliminary baiting the dogs always were in the same formation and that it always was the same dog on the extreme right that went for the boar's right ear and slung himself across the boar's neck and always the same dog on the extreme left that went for the boar's testicles. The leader was said always to keep on feinting at the boar until the latter exposed his right flank sufficiently to give the dog on his right a chance to leap. I have never heard of any other pack of hunting dogs that operated in this way and it may have been unique, but I do not think so, for these dogs had worked out these tactics by themselves and had a strong strain of wild dog. They were all from the same bitch, but of two successive litters; father or fathers unknown.

That particular boar weighed nearly 260 pounds without the viscera torn out by the dogs and after great loss of blood; it was a healthy beast with a healthy skin and fairly large tusks that did not as yet show any sign of decay.

KUALA LUMPUR, F.M.S. L. A. J. RIJK.
December 10, 1928.

[A reference to the statement to which allusion is made in the first para of Mr. Rijk's note, will show that the fact of wild dogs occasionally emasculating their prey is not denied by Mr. Dunbar Brander. He only seeks to maintain that the detachment of the scrotum and testicles of a stag which sometimes takes place is due rather to accident or circumstances than to deliberate design on the part of the dogs. EDS.]

XI.—WILD DOG AND BARKING DEER

When in camp in the West Swa Reserve, in the Yomas, 6 miles or so beyond the last forest bungalow, I was talking 'shop' to my assistant, Mr. D. P. Greenep at about six o'clock on January 29; it was just getting dark when we heard an extraordinay cry, evidently of an animal in pain, which was repeated. We couldn't decide where it came from—even thought it might be some one calling a gyi with a leaf, or a split bamboo. In five minutes Mr. Greenep's boy ran in from his camp, about 50 yards above mine, to say that a gyi (Barking deer) had been killed by a tiger, and two of them had driven it off, and got the gyi. This had happened 50 yards above his camp, in the stream. My wife and the two of us went to investigate : the gyi was dead and stiff, with as far as we could see only one wound, a fang hole on the inside of one of her hind legs. We went to look at the tracks, and as we got into the stream, a spaniel with us got very angry, barking with his hackles well up, and looking at a spot up stream, on the opposite bank. We could see nothing, but when we went on a bit, the tracks shewed that the gyi followed by a wild dog had come down to a pool about 2 ft. deep, along a ledge of rock, and had been seized by the dog on the edge of the water, and knocked down. The pair had apparently struggled across the pool, as we found the place, on the opposite bank where the dog had tried to pull her up out of the water. It was here the two boys had seen her, and after driving off the dog with stones, caught her just before she died, chiefly of fright as far as I can see.

Tracks of wild dogs I had seen myself in the stream and one of my foresters reported that he had met four on a ridge, but as far as the tracks shewed, only one dog was after the gyi, though others may have been 'cutting corners'. He must have been either very keen on the hunt, or very fearless to follow the gyi to within 100 yds. of a camp containing the usual dozen or so fires, and some 30 to 40 men, to say nothing of 6 elephants who were being washed down below.

The dog tracks were not very clear, and there was some doubt as to whether they were those of a dog or a very small leopard. I haven't very much doubt about the one clear track myself, as it shewed claw marks, though it was in mud just where the gyi was first seized. But the spaniel always cowers for a leopard instead of which he was obviously angry, and started to run in ; a leopard, however small, would have left claw marks, as well as those of his teeth, and the boys say the beast that went off was red, though they couldn't see it clearly, being more engrossed in securing a free meal than in accurate observation.

CAMP, NATSEBAUK
TOUNGOO, BURMA.
January 30, 1929.

J. M. D. MACKENZIE, I.F.S.

XII.—BISON EATING BARK

I am sending you herewith a photograph of a tree, *Holarrhena antidysenterica* (Burmese name *Lettok*), showing the fresh tooth-marks of bison. I should be interested to know if it is a common habit of bison to eat the bark of this tree. The photograph was taken by me in the Pidaung Game Sanctuary on June 14, 1928, a few minutes after the bark had been eaten, as the herd had been tracked by me to a salt lick and then back from the salt lick on a parallel line and I came on it about 200 yards from where the photograph was taken.

Unfortunately they happened to be in thick jungle when I came on them and they went off down wind across the open plain and I could not get near enough for a photograph. There were 60 or 70 of them, three herds combined together.

MYITKYINA,
CAMP MAYMYO,
October, 8, 1928.

G. H. OGILVIE,
Deputy Conservator of Forests.

[We understand from Mr. R. C. Morris that the bark of *Wendlandia notoniana*, Wall. is also largely eaten by Bison in Mysore. We regret the photograph will not reproduce. EDS.]

XIII.—' AN ELEPHANT WITH EXTRAORDINARY GLANDS '

Pathological Report on the Condition

Mr. W. S. Millard, of Tunbridge Wells, to whom a portion of the extraordinary gland of the elephant was sent (vide *Bombay Nat. His. Soc. Journal*, vol. xxxii, 1928, No. 4, pp. 792–793) kindly sent this on to me to see if I could have a section cut of it. The piece of tissue sent measured 2 inches in length, by 1 inch in breadth, and had dried up into a hard, horny mass. So hard had this become that it was only possible to remove a portion of it by sawing it off. Dr. Newham, whom I consulted on the matter, suggested we might try softening it with caustic soda. This was done and as the piece then was sufficiently pliable, it was carried through the ordinary alcohols, xylol, etc., and embedded in paraffin. Sections were then cut and stained with hæmatoxylin and eosin and considering the condition of the tissue on arrival, were extraordinarily good.

They showed that the tissue was not glandular as supposed by Mr. Laurie, but consisted of ordinary fibrous tissue with very few cells present. The tumours then, are typical fibromata, very similar in structure to those seen in man and in other animals.

G. CARMICHAEL LOW, M.D., F.R.C.P.

86, BROOK STREET,
GROSVENOR SQUARE,
LONDON, W. 1.
November 21, 1928.

XIV.—A JUNGLE TRAGEDY

Sequel to a fight between two wild bull Elephants.

While camping at Karupanthode (Reserve forests, Central Travancore) news was brought to us by the hill-men (Kuravas) that some ten miles away in the interior of the reserve there had been a furious fight beetween two tuskers as the result of which one was killed. In an instant we were ready and ran to the spot. As we approached within a mile of the place where the dead elephant lay, signs of the death struggle between these monsters of the forest were evident. The shrubs and the bamboo clusters were all trodden down flat on the ground and splintered. A little further on there was evidence of a severer struggle. The ground was still moist and the earth was powdered to clay and mire. As we proceeded we came across three or four more of such arenas that bore the marks of a severe struggle. It would seem that in the affray, one was losing and was attempting to escape: but the other following up closely, hard struggles ensued and that these places marked the scenes of such engagements.

The last arena was really dreadful. There was evidence to show that the vanquished had been brought low to the ground and had been actually dragged along the miry soil a considerable distance. The victor does not seem to have relented: it is quite likely that it was at this time that he pierced the body of his antagonist by his tusks in a number of places—scattered all over the body. This was on a slight precipice and below went merrily babbling along amongst the stones and pebbles a little brook, one of the tributaries of the river Achankovil. Into this stream the disabled body of the vanquished monster was hurled probably by his bitter antagonist. There he lay, as we saw him, an awful spectacle, his body partly washed by the swift-flowing current, partly resting on the banks of the stream. The body was covered by no less than 50 tusk thrusts—all huge gaping wounds that made one think of an old torn up pin-cushion! One of these cruel thrusts piercing on a side of the abdomen, brought out a few coils of the small intestine safely held together in its mesenteric fold.

Examining the wounds we were struck to find that there were a few marks that evidently were quite recent. The hill-men assured us that these fresh wounds were made by the original antagonist and victor, who, his bitterness not in the least appeased by the death of his enemy, would still be paying every night visits to the dead body and venting his malice by piercing the corpse again and again. Their version probably has a bit of coloring: for, they also told us that these nightly visits would continue till the body is all decomposed and the skeleton stands alone bleached in the sun and wind, and that then the victor would scatter the bones about and trample on them—the last act of triumph, the closing scene in the story of a long-cherished hatred and bitterness, a vengeance that ceases not till the last trace of the foe is wiped off the face of the earth!

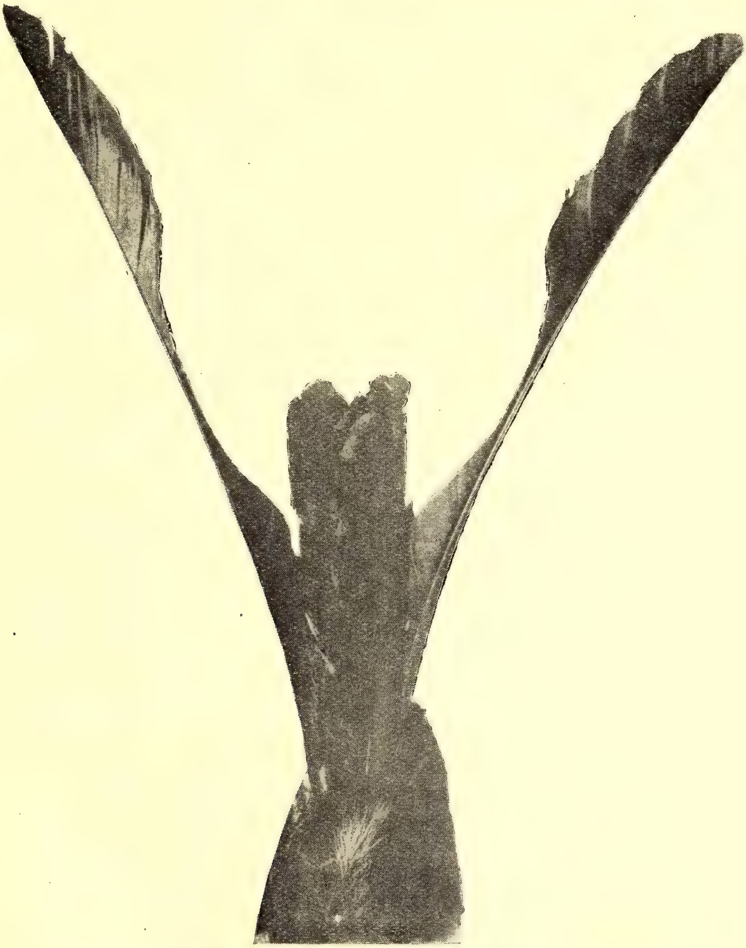
A. P. MATHEW, B.A.,
Lecturer in Biology.

WOMEN'S COLLEGE, TRIVANDRUM,
February 15, 1929

XV.—THE RACKET-FEATHERS OF *DISSEMURUS PARADISEUS*

(*With a photo.*)

In 1862 Jerdon described accurately the structure of the 'rackets' in the outermost tail feathers of the Racket-tailed Drongo, though it is unfortunate that at first sight his description should appear somewhat confusing. He wrote : '. . . the shaft having the terminal end, for about 3½ inches, barbed externally, but towards the tip only on the inner side, and turning inwards, so that the under side becomes uppermost.'



TAIL OF AN IMMATURE *D.p. malabaricus* FROM TRAVANCORE.

Coming later, in 1877, Sharpe (*Catalogue of Birds in the British Museum*, vol. iii, p. 259) omits to mention whether the spatula is produced by the outer or the inner web of the vane.

On page 325, vol. i of the *Fauna* (1st edn.), Oates writes: ' . . . . the terminal portion of which (the lateral tail-feathers) is webbed on the outside for a distance of about four inches and twisted upwards. The web on the inner side of the shaft is very narrow.'

Stuart Baker perpetuates Oates' misleading statement in the second edition of the *Fauna* (vol. ii, p. 376) by saying ' . . . having the rackets of the long outer tail feathers webbed broadly on the outer side but only very narrowly on the inner.'

More recently still, Mr. H. Whistler on page 315, vol. xxxiii, (No. 2) of this Journal, in the course of his paper on ' The Study of Indian Birds' follows his predecesors and says: In *Dissemurus* the racket is composed of the outer web of the feather, the inner web being absent except for just sufficient at the end to emphasize a twist of the racket . . . . ' To make his meaning clearer, Mr. Whistler has illustrated the tail of *Dissemurus paradiseus* which shows perfectly the condition he has described!

In matters of this nature it is obviously customary for one writer to follow another unquestioningly and seldom to stop and examine things for himself. As it is not every amateur who is fortunate enough to have a series before him for comparison, it is desirable that this oft-repeated fallacy should now be finally disposed of.

I have carefully examined all the skins in the Society's collection besides many others, and find that the racket at the end of the outermost elongated tail feathers is *not* formed by the outer web of the vane at all as stated by the recent writers quoted above, but by the *inner* web as recorded by Jerdon undoubtedly as a result of personal investigation.

The appearance of the racket being composed of the outer web is due to a twist in the rachis just above the spatula which in many cases is practically imperceptible unless the main-shaft be followed right down its length with the aid of a pocket lens.

I reproduce a photograph of a rather unusual specimen in our collection where the rachis is not completely bare along its middle length, but retains the barbs on the inner web, which, as will be seen, expands lower down into the spatula. This was the specimen that led me to examine the others and to verify that the racket actually owes its existence to the *inner* and not to the outer web.

BOMBAY NAT. HIST. SOCIETY. SÁLIM A. ALI.
6, APOLLO STREET,
March 12, 1929.

XVI.—A NOTE ON THE BREEDING OF THE TAILOR-BIRD (*ORTHOTOMUS SUTORIUS*)

Several descriptions of the operations of Tailor-Birds in constructing their nests have been published, but, as they all differ in some small details from my own observations last summer I venture to think that those observations may possibly be of interest.

The nest in question was constructed in the leaves of a croton in a pot on the top step leading to the front verandah of my bungalow. It was placed on the side of the plant next to the steps, so that everyone entering or leaving the bungalow had to pass within a foot or two of it, besides which my dog was in the habit of lying exactly under the nest, which was then less than three feet from her head.

The following observations are copied direct from my diary :—

June 8, 1928. A pair of Tailor-Birds have begun a nest on the verandah in a croton. About three stitches have been put in, and several holes bored for more.

June 9. Tailor-Birds very busy. Male seems to do most of the work. The sewing of the leaves together seems to be almost complete. Material used for thread seems mostly to be obtained from spiders' seed-bags. A little material for the actual nest has been placed in position. Raw cotton placed about six feet from the nest entirely ignored. Heavy rain from about 4.30 p.m. to 6.30 p.m., during which no work was done on nest.

June 10. Cock working hard on nest all morning : both of them in the evening. A few more stitches put in, but most of the work consisted of carrying white down.

June 11. Both Tailor-Birds working. Nest appeared to be nearly finished when I left for Mount Abu in the afternoon.

June 20. The Tailor-Bird was sitting on her eggs for the first time about 5.30 p.m.

June 29. The Sun-bird and Tailor-Bird are still sitting. The latter frequently leaves the nest during the day for fairly long periods. She seems to try hard not to be seen leaving it, but is less particular about returning. She flies to the foot of the plant and climbs up to the nest hidden by the leaves. She always returns to the nest if rain begins to fall.

6.45 p.m. Two of the Tailor-Birds hatched.

June 30. Both Tailor-Birds feeding the young, female seems to come oftener than male.

July 2 to *7.* Out of the station.

July 8. The young Tailor-Birds are now well grown, five in number. Both parents feed them and take their share in the sanitation of the nest. The hen is the bolder of the two in approaching the nest under observation. The cock draws considerable attention to himself in approaching the nest with food by calling loudly. The hen comes in silence. Both perch on the pot and hop from leaf to leaf till they enter the nest, and both fly away direct on leaving it. They seem to find much of the food in the pots on the back verandah, and frequently take a short cut to it through the bungalow.

July 9. Young Tailor-Birds began to leave nest at 4.30 p.m., some of them breaking away a few stitches at the back of the nest, and coming out that way. Two only were left in the nest at 5.0 p.m., when I went out, and only one at 7.30 p.m., when I returned.

July 10. One Tailor-Bird chick was in the nest at 10.0 p.m. last night, but has left since, and none of the family seem to be about to-day.

July 11. Whole Tailor-Bird family feeding in the garden at 8.45 a.m.

July 13. Tailor-Bird family feeding in the garden. Impossible to count the young, as they are constantly slipping in and out of the bushes. Later in the day the old birds hung round the nest a little, and the cock entered it.

July 14. Tailor-Bird family still about.

July 15. An adult Tailor-Bird again entered the nest to-day.

July 18. In the evening the young Tailor-Birds were in the garden.

July 19. Young and old Tailor-Birds in the bushes.

July 24. Young Tailor-Birds still being fed by their parents in the garden.

After this date the young were not again seen, though the old birds continued to live in the garden. On September 4 they were feeding another brood of young in a bed of Sunflowers. The young birds had evidently only just left the nest.

MHOW, REV. F. S. BRIGGS.
CENTRAL INDIA.

XVII.—A STRANGE PET

(*With a photo*)

The photograph is of ' Suleiman ' a cheerful young hoopoe, who accompanied me for over a month during my trip to Gilgit and the Karakoram.

He was dug out from a cairn, but not without a stout struggle, much hissings and swayings of his head. (This behaviour I have noticed is a peculiarity of the hoopoes and is strangely reminiscent of the cobra.)

Two days of voluntary starvation brought Suleiman to his senses—and me to mine—for waddling up under cover of the table he drove his long bill through a gap in my slipper under my big toe nail and emitted a doleful ' cheep '.

Thereafter we became friends and Suleiman had his hard-boiled eggs every day though he would not eat the yolk, no matter how hungry he was.

Difficulties arose as to his *mode de conveyance* when we began our trek, and the only device I found beneficial to him was to perch him on my hat. As he grew older he rather wearied of this and broke the monotony of a long march by taking short flights, but always returning to his ' perch '. He had his own travelling basket which he detested, and the greatest penalty for keeping his ' perch ' waiting was a good shaking up in the basket.

As we moved into the higher altitudes our bond of friendship became stouter. Suleiman would snuggle into my coat in the day—while I sat skinning—and persisted in wanting to share my bed at nights. The temperature then hovered just over zero and after a night of snow storms, followed a blizzard, I missed the cheerful ' cheep ' and a long bill probing into my ear-hole. This was Suleiman's method of waking me up to snuggle under the flaps of my furry head gear.

V. S. LA PERSONNE.

BOMBAY NATURAL HISTORY SOCIETY,
6, APOLLO STREET,
January 8, 1929.

XVIII.—THE STORK-BILLED KINGFISHER (*RAMPHALCYON CAPENSIS GURIAL*) EATING BIRDS

Can you or any of your correspondents kindly tell me if *Ramphalcyon capensis gurial*—the Brown-headed Stork-billed Kingfisher, is known to eat other birds ? This morning I saw this bird sitting on the branch of a tree near a stream above a cane-brake, greedily eating what I think, by what I could see of it, was a red-vented bulbul. As the meal was already begun when I first saw the Kingfisher, I do not know if it was a freshly killed bird or not. I shall be most grateful for information about this.

DANTI FOREST BUNGALOW, (MISS) SARAH WYATT.
HULDWANI DIVISION,
January 12, 1929.

[The partiality of kingfishers for food very different from what their name would imply, is well-known. Field mice, lizards, frogs, insects and crabs are freely devoured at all times. EHA observed that a *Halcyon smyrnensis* swallowed small birds when kept in an aviary, and Stuart Baker has seen a stork-billed kingfisher take a young myna from its nest and devour it. All available evidence therefore goes to show that several members of this family are possibly addicted to help themselves to young birds whenever they can conveniently come by them. EDS.]

XIX.—MIGRATION OF THE PIED CRESTED CUCKOO (*CLAMATOR JACOBINUS*)

In view of the article on the 'Migration of the Pied Crested Cuckoo' in a recent number of the Society's Journal, it may be of interest to record that this bird is common in the open scrubby plains round Penipatam in Mysore State, some forty miles west of Mysore City, near the Coorg boundary. I have only noticed it in the last few months, as I only visit the locality occasionally, but I believe it is a permanent resident there. It does not occur through the greater part of Coorg as the country is well watered and thickly wooded, there being but little of the bare open scrub land that it appears to prefer.

YEMMI GOONDI, POLLIBETTA, F. N. BETTS.
S. COORG.
November 18, 1928.

XX.—DISTRIBUTION OF THE BROWN SHRIKE (*LANIUS CRISTATUS CRISTATUS*)

Can you tell me if the Brown Shrike, *Lanius cristatus cristatus*, is a visitor to Southern India? A shrike that appears to correspond exactly to the description of this bird in Stuart Baker's Fauna of British India, is one of the commonest cold weather visitors here. The *Fauna* only says however: 'In winter it is found practically throughout Northern India as far south as Mount Abu on the west and Orissa on the east.' According to Waite (*Birds of Ceylon*) it is a common North-east Monsoon migrant to Ceylon and I have frequently seen it near Newara Eliya in that island at an elevation of 6,000 ft.

S. COORG. F. N. BETTS.
November 18, 1928.

[Stuart Baker has obviously overlooked the distribution of this species in South India. In the first edition of the *Fauna*, Oates gives it as 'a winter visitor to the whole of the Empire except that portion lying to the west of a line roughly drawn from the Sutlej Valley to Mt. Abu; Ceylon; the Andamans.' According to H. S. Ferguson (The Birds of Travancore, *B. N. H. S. Jour.* vol. i.) this shrike is quite common in that area between September and April. EDS.]

XX—A HAWK INCIDENT

One afternoon at about 3 p.m. a hawk entered my chicken-run and caught one of my chickens. The alarm was at once given by the rest of the chickens and, proceeding to investigate, I saw the hawk with the chicken. As soon as the hawk spotted me it tried to escape, and I was extremely surprised at seeing it unable to rise off the ground. One of my servants rushed up to the bird and clubbed it with a stick. On examination I found the hawk's talons so deeply imbedded in the spines of the chicken that it was unable to free itself. For this reason, I presume, it was unable to rise. The incident struck me as being rather strange, as the hawk was a huge bird and in extremely good condition, weighing 6¾ lb., whereas the chicken was only 1½ lb.

I should like to hear of a reason for the hawk's inability to rise.

BURMA MILITARY POLICE, L. E. MACGREGOR,
MYITKYINA, UPPER BURMA. *Captain.*

XXII.—NOTES ON WOODCOCK NEAR RANGOON

There having been a certain amount of interest shown in woodcock, as evidenced by the various articles in your Journal as well as in the local Press, a few observations may be of interest to some of your readers. The woodcock near Rangoon is by no means the *rara avis* some people imagine; on certain grounds within forty-miles from Rangoon they can be found regularly, as the following may illustrate: Ground 'A' is a swamp surrounded by low scrub jungle and paddy fields; the swamp dries up completely in March. I visited this ground in all six times last year, and failed only on one occasion in getting woodcock; in all ten woodcock were bagged here, and one more was seen. Ground 'B' is also low scrub jungle, quite close to the Forest Reserve, with an intervening narrow stretch of grazing ground, which at this time of the year is already quite dry. Here my beaters have seen regularly a woodcock in a certain beat, but I did not get a shot at it until early December; since then, with the accustomed regularity in which one woodcock takes up the residence of his defunct brother, I have seen another in this beat, but we were unable to get a shot at it. About a mile away from this beat I missed a woodcock last year. A few days ago I saw one (? 2) woodcock in a beat along a narrow almost dried up streamlet, over-grown with scrub jungle, and flanked by paddy fields. On a similar ground a few miles away a few years ago woodcock were shot, but none appear to have been seen lately. One or two woodcock were shot even nearer to Rangoon, about thirty miles away, in a little bit of swampy low jungle. All woodcock were shot in Junglefowl beats, with beaters and not with dogs. There can be very little doubt, that woodcock will be found on a number of grounds near Rangoon, provided there is a swamp, and some low scrub jungle.

It seems a puzzle on what woodcock feed during February (the season closes end of February) and later as there is not a drop of water then on the above described grounds, and the soil is as hard as a brick. As the birds shot during February are in prime condition, I should be glad if any of your readers can offer any information as to what these birds exist upon in the dry weather.

RANGOON, E. O. BLOECH.
January 2, 1929.

XXIII.—OCCURRENCE OF THE BAR-TAILED GODWIT (*LIMOSA LAPPONICA LAPPONICA*) IN SÁLSETTE (BOMBAY SUBURBAN DISTRICT)

While going through the Society's collection of birds obtained in Bombay and its immediate environs, I came upon an unnamed specimen which is undoubtedly the Bar-tailed Godwit (*Limosa lapponica lapponica*). The bird which is unsexed was shot by Lieut. Tebbutt at Bhayandar creek, about 20 miles to the north of Bombay city. The measurements are as follows:—

Bill 82·5 mm.; Tarsus 49 mm.; Wing 210 mm.

As Bombay is far too south of its hitherto known range in the Indian Empire, I consider the occurrence worth recording.

SĀLIM A. ALI.

Bombay Natural History Society,
6 Apollo Street,
March 14, 1929.

XXIVI.—OCCURRENCE OF THE WHITE-FRONTED GOOSE (*ANSER ALBIFRONS ALBIFRONS*) IN THE UNITED PROVINCES

I was shooting with a small party about 20 miles from here on November 15. The bag included two geese, one bar-headed and one young white-fronted goose. On reading Stuart Baker's book I see that the latter goose is rarely if ever found east of the Punjab. I thought perhaps the incident was worthy of note.

M. J. W. O'DONOVAN,
Captain.

The Royal Irish Fusiliers,
Agra.
November 22, 1928.

[Unfortunately Capt. O'Donovan was unable to let us have any portion of the skin for confirmation, but from the size of the bird and the general description in Stuart Baker's book he is convinced as to its identity. Eds.]

XXV.—POCHARD PERCHING ON A TREE

Last December I was out shooting duck in the lake at Rahalia about 2½ miles from the Railway Station of Mohoba in the Central Provinces and was surprised to find a White-eyed Pochard sitting on a tree close to the bathing ghat. The bird was not wounded, nor was he one that had been flushed, as I had not started shooting. As I have never known this duck to perch on a tree I write this note.

A. BAYLEY-de CASTRO,
Lieut., I.M.D.

Quetta, Baluchistan,
February 20, 1929.

XXVI.—THE KISSING HABIT AMONG BIRDS AND ANIMALS

> ' . . every power in nature seems
> To teach us how to love and kiss.'
>
> *Victor Hugo.*

Kissing is a habit that is common among animals, although Voltaire stated that to man alone among animals are known the embrace and the joy of the kiss. Ludgwig Hopf (The Human Species) notes that kissing as a sign of affection is not entirely peculiar to man. 'Many animals,' he says, 'appear to kiss one another. Dogs, and less often cats, lick with their tongues other dogs and men upon whom they have bestowed their affection.'

Licking with the tongue or merely touching the lips as a sign of affection is common amongst mammals. Animals have the maternal impulse to kiss the young by licking them.

It is obvious that the kiss among many animals is an olfactory one. 'Licking the hand, or, where it is accessible, the face, is a common display of attachment on a dog's part'; writes Spencer, 'and when we remember how keen must be the olfactory sense by which a dog traces his master, we cannot doubt that to his gustatory sense, too, there is yielded some impression associated with those pleasures of affection which his master's presence gives.'

The caressing of the antennæ practised by snails and various insects during sexual intercourse is of the nature of a kiss. Hurstcot says: 'The human love embrace is an advance on that of the beast; but the principle of physcial contact is equally common to human and animal embraces.'[1]. The billing and cooing of birds during their love season is undoubtedly a form of caress, as is also their nibbling at and preening of each other. Birds use their bills for a kind of caress and the cataglottism of pigeons are typical. 'You would think,' writes Charles Buxton, 'if our lips were made of horn and stuck out a foot or two from our faces, kisses at any rate would be done for. Not so. No creatures kiss each other as much as birds.' Catullus stated that the dove is said to surpass all others in the indefatigable ardour of its billing kisses. And Thomas Campion wrote:—

> 'The Dove alone expresses
> Her fervencie in kisses,
> Of all most loving.'

Edmund Selous says that the female sea-gull looks fondly up at the male, and 'raising her bill to his, as though beseeching a kiss, just touches with it, in raising, the feathers of the throat—an action light, but full of endearment. Among the higher animals, such as the bear and the dog, there is a development, which seems to lead up to those forms of the act most prevalent among the lower races of man and also characteristic of the peoples of Eastern Asia. Far more similar, however, to the civilized human kiss is the habit attested for cats of pressing or squeezing one another's nose.

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[1] *Love Ethics*, John Hurstcot.

Darwin cites the behaviour of two chimpanzees, rather older animals than those generally imported into England. 'They sat opposite, touching each other with their much protruded lips; and the one put his hand on the shoulder of the other. They then mutually folded each other in their arms. Afterwards they stood up, each with one arm on the shoulder of the other, and yelled with delight.[1]'

The fact that the kissing habit is so common among animals has given rise to the belief that it is instinctive in human beings. Even in those countries where the kiss, as we understand it, is unknown, mothers have been observed to fondle their infants with their lips, and this maternal caress certainly does appear to be instinctive both in animals and human beings.

C/o MESSRS. GRINDLAY & CO., LTD., BOMBAY.

A. E. MAHON, D.S.O.,
Colonel.

XXVII.—DIFFERENT BIRDS NESTING IN COMPANY

The following note on the nidification of the Indian Red Turtle Dove (*Œnopopelia tranquebarica*) may be of interest. In the compound there is a 'Nimb Tree' (*Melia indica*) about 30 feet high on which a King Crow, or common drongo, has a nest of young ones; and on the same tree under the King Crow's protection no less than seven Red Turtle Doves are seated on eggs.

BHANDARA, C. P.
May 18, 1928.

W. A. TUCKER.
Deputy Commissioner.

[A number of notes have appeared in the Journal on the same subject before. We would refer readers to one by Mr. G. O. Allen, I.C.S. (vol. xxvi, p. 1044) and another by Mr. H. W. Waite (vol. xxvii, p. 171).

In all the instances cited, there has been one Drongo's nest in the trees tenanted by doves, green pigeons and bulbuls, and it may well be that the presence of this indomitable bully serves to keep would-be intruders at a respectful distance. EDS.]

XXVIII.—BIRD MOVEMENTS IN COORG

I append the dates of arrival of some winter migrants in this district, which may be of interest:—

August 31, 1928.—Grey Wagtail;
September 11, 1928.—Brown Shrike;
September 30, 1928.—Green Sandpiper, Eastern Swallow;
October 15, 1928.—Indian Pitta;
October 16, 1928.—Forest Wagtail;
October 27, 1928.—Blue-headed Rock Thrush;
November 4, 1928.—Pale Harrier.

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[1] Charles Darwin, 'The Expression of the Emotions.'

The following are local migrants which only spend the cold weather in this district of Coorg but appear to be permanent residents in the dry Mysore plains:

October 10.—Common Bee-eater;

October 25.—Indian Oriole.

The Indian Pitta and the Chesnut-headed Bee-eater appear to be birds of passage, as they are very common for a few days in the spring and again in the autumn but are never to be seen at any other times.

S. COORG. F. N. BETTS.
November 18, 1928.

XXIX—MIGRATION OF WILDFOWL

Since the publication of the last number of the Journal, the following recoveries of ringed birds have been reported to us.

In future we propose to tabulate all such reports from time to time in the Society's Journal.

All comments on the results will be reserved until a sufficiency of data has accumulated in this manner, except only by way of explanation where considered desirable :—

Place of Ringing	No.	Date	Species	Ringed by	Date of Recovery	Locality	Remarks
Dhar State	?	Feb. '26	Pintail (*Dafila acuta*)	H. H. Late Maharaja	29- 5-27	River Tira left branch of Tiga (a tributary of Chatanga, (Middle Tunguska) Siberia.	Captured by a native.
Dhar State	43	Feb. '26	Wigeon (*Mareca penelope*)	Do.	15- 8-28	45 k.m. S of Tara, lying N. of Omsk on River Irtysh 56° 44′ N, 74° 17′ E.	The bird was in moult and could not fly.
Dhar State	?	Feb. '26	Pochard (*Nyroca ferina*)	Do.	28-12-28	One of the tanks in Dhar State	Shot by Col. Davenport.

Place of Ringing	No.	Date	Species	Ringed by	Date of Recovery	Locality	Remarks
Jhajja, Bahawalpur State	2182	Dec. 12, '28	Common Teal (*Querquedula crecca*) ♂	Bahawalpur Durbar	12- 2-29	Tochi (Gambila) River, near Bannu, N.W.F.P. circa 32°N. lat. 71° E. long.	Shot after 71 days about 260 miles NNW.
Rajghat, Bettiah, Champran (B & O)	469	Apr. 1, '29	Jarganey Teal *Querqudula circia* ♂	A. C. Harman	11- 4-29	Jhandola, Muzaffarpur District (Bihar & Orissa)	...
Sujawal, Sind	1803	Feb. 9, '29	Pintail (*Anas acuta*) ♂	Meherally shah Bukhari	25- 2-29	Thain Dhund, Sujawal Sind	...
Sujawal, Sind	1820	Feb 9, '29	White-eyed Pochard (*Nyroca rufa*)	Do.	23- 2-29	Near Sujawal (Sind)	...
Kashgar (Chinese Turkestan)	2952	Jan. 17, '29	Mallard (*Anas platyrhyncha*) ♂	Capt. G. Sherriff, R.A.	24- 1-29	A few miles from Kashgar	Caught by trained falcon
Jhajjd, Bahawalpur State	2111	Dec. 11, '28	Red-crested Pochard (*Netta rufina*) ♀	Bahawalpur Durbar	6- 3- 29	On a lake near River Amu Daria (Russian Turkestan) 37° 21′ N. lat 66° 20′ E. long	Circa 580 miles NNW. of Bahawalpur

No. 3 is a very interesting record. The bird was recovered not far from where it was ringed almost three years previously, during which time three journeys to its breeding haunts and three back again are indicated !

One of the objects of our Ringing Scheme, it will be recalled, is to ascertain whether migrants return from the same breeding haunts to the same winter quarters year after year.

BOMBAY NATURAL HISTORY SOCIETY, EDITORS.
6, APOLLO STREET.
March 12, 1929.

XXX.—THE DISTRIBUTION OF THE MUGGER

I should be glad if any reader of this Journal can tell me of an authentic record of the 'Mugger' (*Crocodylus palustris*) in Burma. Its distribution, as given by Boulenger in his *Fauna of British India* is India, Ceylon, Burma, the Malay Peninsula and Archipelago. This as I showed in 1919 (Journ. Nat. Hist. Soc. Siam, iii, p. 220) was not correct. The freshwater crocodile of the Indo-Chinese region as distinct from *C. porosus* which is marine or estuarine in its habits—is *Crocodylus siamensis*, its range being through Siam, French Indo-China and ? the northern part of the Malay Peninsula. Annandale (Rec. Ind. Mus., viii, 1912, p. 38) has recorded the 'Mugger' from the Brahmaputra, Darrang district, Assam, but I do not know of any specimen or statement to show that it exists further east than this. If any reader can furnish one I should be grateful. A specimen, or parts of one, a skull, a dried head or a piece of the skin of the back, would serve for identification and would, I am sure, be welcomed by the Society's Museum.

LONDON, MALCOLM SMITH.
November, 1928.

XXXI—AN UNPLEASANT EXPERIENCE WITH A PYTHON

When staying with a planter friend, Mr. Baker, who owns a cocoa nut estate situated on the eastern shore of the Travancore back-water, he mentioned that one of his coolies recently had an unpleasant experience with a python when wading in shallow water to catch fish. The fish here lie frequently in hollows and cavities in the mud embankments and are caught by covering the entrance of a hole with a net and then by driving the fish out with a stick. In this particular instance the cooly, after adjusting his net, noticed something just under the surface of the water which in the dim light of the cave appeared to be a large fish that would not respond to the persuasion of his stick, he therefore thrust in his leg to investigate and was at once seized by the occupant of the hole who turned out to be a nine-foot python. The snake firstly threw one coil round the man's thigh and subsequently in the struggle succeeded in getting two more round his body raising its head and neck to the height of the man's shoulder. The terror stricken cooly seized the neck of the snake and managed to hold it at arm's length; then a violent struggle ensued for the next two minutes or so between man and snake. The cooly's shouts were luckily heard by another estate man who ran to his assistance. The rescuer was fortunately at the time carrying a sharp sickle the blade of which he managed to insert between one of the python's coils and the cooly's body and succeeded in cutting the snake in two. This took time however, and when freed from the severe constriction the cooly was found to be unconscious, but had not sustained any serious injury. He remained however paralysed for about three months and then made a gradual and steady recovery to complete health. Mr. Baker says that pythons appear each year in considerable numbers on his estate during the rainy season and depart at the end of the monsoon. During this period they live almost exclusively on fish and rats which they capture without difficulty in the swamps and pools which at this time of the year contain fresh water.

The largest specimen that Mr. Baker has seen in these parts measured 15 feet and was of a lightish blue-brown colour; he adds that he welcomes these creatures on his estate as they are excellent ratters and assist materially in keeping these pests of the cocoanut tree under control.

I send this note chiefly to illustrate the extraordinary strength of so small a python.

BANGALORE,
February 18, 1929.

R. W. KEAYS.

XXXII.—A TRUE SNAKE STORY

At about 6 p.m. one evening one of my servants reported that he had seen a snake enter a hole in a wall. I went out and looked at the hole and could see the snake quite distinctly coiled up in it. I got hold of a stick and sat over the hole and waited for the snake to come out. Shortly afterwards the snake began to come out and I clubbed it. I then pulled the snake, and when it was nearly out I noticed that another snake was holding on to its tail. I continued to pull and the other snake was hauled out and slain in the same way as the first. On pulling out the second, a third was found hanging on to its tail end. This was pulled out still hanging on and slain. This seems a tall story, but the fact remains that three banded kraits were slain by me, one after the other, each one hanging on to the tail-end of the previous one.

L. E. MACGREGOR,
Captain.

BURMA MILITARY POLICE,
MYITKYINA,
UPPER BURMA.

XXXIII.—A KRAIT (*BUNGARUS CÆRULEUS*) WITH DIVIDED SUB-CAUDALS

It may be of interest to record that I came across a very fine specimen of a Krait (*Bungarus cæruleus*) with only the 10th and 11th sub-caudals divided counting from the anal downwards. I take it this is abnormal as I see no mention of it in Col. Wall's book or in any of the other articles on snakes printed in the Society's journals.

PAKSEY,
PABNA DISTRICT,
BENGAL,
September 2, 1928.

P. MURPHY.

XXXIV.—RECOVERY FROM THE BITE OF A PHOORSA (*ECHIS CARINATA*)

In vol. xxxii, No. 4, of the *Bombay Natural History Society's Journal*, I see an account of the recovery from the bite of a phoorsa, in which there is some doubt whether any poison was injected when the man was bitten. I can give an instance of complete recovery within twelve hours and with no doubt whatever as to the injection of poison from the fangs of the viper. Years ago my brother, the late Mr. John Strip, Assistant Collector of Customs, Karachi, and I were out after ibex and oorial in the Pabb Hills about thirty miles from Karachi, and early one morning, while returning from our trip, one of our camelmen, as he was getting his camel to be saddled, was bitten by a phoorsa on the foot. He had a stick in his hand and killed the reptile bringing it to our tent for us to see. My brother, who always carried ammonia and other medicines in his shooting trips, promptly gave the man a stiff dose in water making him move about briskly as he was beginning to feel drowsy, a sure symptom of the effect of the poison. After that we had to do a stage of twelve miles on our camels with the result that the jolting of his camel prevented the poison having greater effect on the man. We halted for a short time at Band Muradkhan and the man being still a bit drowsy got another dose of ammonia. When we reached Karachi in the evening he was all right and made a hearty meal. He had quite recovered.

MEREWETHER ROAD, S. A. STRIP.
KARACHI,
October 31, 1928.

XXXV.—OCCURRENCE OF THE 'SLIMY' COECILIAN (*ICHTHYOPHIS GLUTINOSUS*, BOULENGER) IN PANCHGANI

The Coecilians are worm-like and blind Amphibians which inhabit damp situations and burrow in soft mud. In the *Fauna of British India*, Boulenger describes three genera and five species of these Batrachians.

In the collection of snakes, sent to me for identification by the Rev. E. Blatter, I came across a specimen of *Ichthyophis glutinosus*. It is interesting to note that this species has not been recorded so far from Panchgani (Satara District) or its vicinity, in spite of the fact, that its cousin—*Ichthyophis monochrcus*—has been recorded from Malabar, Western Ghats, Surat and Khandalla. In the Fauna Volume the range of *I. glutinosus* is given as ' mountains of Ceylon, Malabar, Eastern Himalyas, Khasi Hills, Burma, Siam, Malay Peninsula, Sumatra, Borneo, Java.' I am much obliged to Col. Sewell and Dr. Prashad for kindly informing me that a variety of

I. glutinosus, entitled *tricolor* has been recorded from Travancore and Cochin, but not the type species. From the above-mentioned facts it becomes evident that the presence of *I. glutinosus* at Panchgani is worth recording.

BIOLOGY DEPARTMENT,
ST. XAVIER'S COLLEGE,
BOMBAY,
October 21, 1928.

J. P. MULLAN.

XXXVI.—DO FROGS EAT SNAKES?

Last year, while I was supervising the Intermediate class in their Practical Work in Zoology, my attention was drawn by a student to the much swollen stomach of a frog (*Rana tigrina*) dissected by him. On cutting open the stomach, we found to our great surprise a wolf-snake (*Lycodon aulicus*), one foot long. It was not much affected by the gastric juice; only at the neck, near the anus and at three places in the mid-body disintegration had set in. The head was intact, and there was no doubt about the species of the snake. I could not definitely ascertain whether the frog had eaten it alive or dead. These snakes, though menacing in attitude have a nervous disposition and are much susceptible to injury. Once the frog held its victim between its jaws, the latter might have made a few futile efforts to bite at the slimy and smooth skin of the amphibian and ultimately succumbed. Of course, I do not regard this as sufficient evidence to prove that the frog preyed upon a living snake; far from it. I merely suggested that it is not unlikely. The more probable explanation seems to be that the snake was eaten, already dead.

BENI CHARAN MAHENDRA, M.SC.,
Lecturer on Zoology.

ST. JOHN'S COLLEGE,
AGRA,
November 29, 1928.

[Snakes do not infrequently figure on the menu of the Bull Frog (*Rana tigrina*). On page 500, vol. ix of the Journal Mr. E. H. Aitken records seeing one in the act of swallowing a snake, while Mr. Sundara Raj mentions a specimen sent to the Madras Museum from Travancore which had swallowed over three-quarters of the length of a young Rat Snake (*Ptyas mucosus*) measuring 34½ inches.

The Bull Frog's dietary is extremely comprehensive and few living things that can be easily overcome are passed by. We have records of its swallowing alive garden lizards (*Calotes*), a toad, chickens, a wounded snipe, sparrows, a pitta, mole crickets, scarab beetles and the cocoon of a psychid moth made of sharp babool spines, with larva inside.

D. Gostling (vol x, p. 151) removed 3 Guinea-fowl chicks (about a week old) from the stomach of a Bull Frog that had become a menace to his poultry yard, and on another occasion a dead individual on being cut open was found to have swallowed a scorpion, the obvious cause of his demise.

The Emperor Akbar trained Bull Frogs to capture sparrows. EDS.]

XXXVII.—ANIMAL BAROMETERS

Yellow frogs are the males of *Rana tigrina*, the largest of Indian frogs, which invariably make their appearance on some spot of ground converted into a quagmire of shallow pools of water after a heavy fall of rain. Here in Bombay a piece of waste land in a congested part of Mazagon was converted into a series of shallow pools littered with heaps of old disused bricks, and in the early morning hours of June 12, after a night of heavy rain, great yellow frogs were observed bellowing and baying and leaping about in the slushy pools of mire and water impelled by that universal *cherchez la femme* instinct implanted in the bosoms of frogs, beasts, and humans to show off before the fair sex. There were about ten 'he's' to every 'she' and the competition for partners amongst the 'he' bull frogs was consequently rather keen. The females were of a uniform muddy brown colour, harmonizing in tint with the muddy bricks and clods of earth submerged in pools of dirty rain water and surrounded at times by three or four gaudy coloured males in their liveries of flunkey yellow who appeared to be bawling at the top of their voices a refrain which suggested the lines from the famous play of Aristophanes which will bear repetition if only for its onomatopoetic and nonsensical jingle :

'We've a right'
'We've a right'
'And we croak at ye for spite'
'We've a right'
'We've a right'
'Day and night'
'Day and night'
'Night and day'.
'Still to creak and croak away'
'We proceed as we began'
Kooash! Kooash.

There is nothing mysterious about the sudden appearance in great numbers of these bull frogs at the onset of the rains, who during the dry hot months remain hidden away under broken bits of masonry and in the recesses of cool cisterns and drains undergoing a sexual colour change from dark or brownish-green to the deep canary yellow assumed by the males when they burst forth in all their splendour at the breaking of the rains. The yellow nuptial dress rapidly fades to the usual normal tint with the exception perhaps of a faint yellow line traced along the back from the posterior to the front indicative of the sex of a batrachian reveller who bellowed his loudest on some dark morning at the onset of the monsoons. The frogs are in fact animal barometers as on the same piece of ground already referred to they appeared on June 16, 1927, the date of the bursting of the monsoon that year in Bombay that is four days later than 1928 (June 12). One of the male frogs it was observed had not assumed his full nuptial garb of flunky yellow but was in a transition state. The monsoon was a bit too early for him! It had no effect however on his voice as he bellowed as loudly as the other masculine suitors, relying perhaps on his vocal powers. These great bull frogs are very voracious. On one occasion a large frog was seen to leap out of a cistern and seize by the head a small duckling which was rescued with difficulty from the predatory maw of the batrachian.

THE STRANGER'S HOME,
MAZAGON,
BOMBAY.

H. JOUGUET.

XXXVIII.—MIGRATION OF BUTTERFLIES

With reference to your enquiry regarding migratory flights of Indian butterflies, I have repeatedly seen large flights of *Catopsilia pomona* in Kumaon. These appear to be of two different natures, as follows:—

(*a*) In more or less of a herd.
(*b*) In single file.

In the former, which I have seen at different times of the day and, on one occasion, as late as 6 p.m., the formation is irregular, elevation from 30 to 100 feet and the speed comparatively slow, whereas in the latter the flight is characterized by great rapidity and purposefulness and, as far as I have seen, is always at an elevation of less than 15 feet.

On one occasion last year I counted upwards of 200 insects in a flight of the latter nature, each insect at a regular interval after the other and so close to me that I was able to determine the *catilla* variety, of which there were several, from the common type. The line of flight was across a flower garden in which other Catopsiliads were feeding but which appeared to have no attractions for the migrants as none slackened speed but continued in a straight line until out of sight.

It would appear that 'Herd' formation and slow speed is the order of the day when a long migration is contemplated and single file and rapid speed when the goal is comparatively near. At the same time it is remarkable that, when passing over an attractive flower garden, swarming with other butterflies, no single member of the flight should be sufficiently distracted to even check its speed.

BOMBAY,
August 25, 1928.

G. WESCHE-DART.

XXXIX.—OCCURRENCE OF THE OAK-LEAF BUTTERFLY (*KALLIMA HORSFIELDI*) NEAR BOMBAY

I sould be interested to hear whether any member can give me any information as to whether this butterfly is a regular inhabitant of the Salsette country.

During the past month (August) in the vicinity of Borivli, I have taken several specimens of *wardi* (= *doubledayi*, Moore) the very small wet-season form of *horsfieldi*. According to Fruhstorfer this form is common in Kanara but I can find no record of its previous capture as far north as Bombay.

BOMBAY, G. WESCHE-DART.
August 24, 1928.

[There is no doubt that this species inhabits Salsette throughout the year as we have met with it in almost every month. The dry season form appears to be somewhat larger and paler coloured and prefers fallen leaves and the ground to the tree trunks to which its wet season congener is partial. EDS.]

XL.—NOTE ON THE BREEDING OF *TERIAS LÆTA* AND *T. VENATA* AND THE PROBABILITY OF THEIR BEING SEASONAL FORMS OF A SINGLE SPECIES

When dealing with the genus *Terias*, in the series of articles on Common Butterflies of the Plains—vol. xxii, p. 525 of the Journal—Mr. Bell has referred to the fact that in Kanara, a district where the monsoons are very heavy, *T. læta* does not occur during the rainy season, and has suggested, as a possible explanation, that *læta* is not a distinct species but a dry season form of *T. venata*. But he added, however, that there was no evidence on the subject as there was no record of the breeding of either species.

I have recently succeeded in finding larvæ and in breeding imagos of both forms and the evidence obtained, though not entirely conclusive, points strongly to the probability, in my opinion almost the certainty, of Mr. Bell's suggestion being a definite fact. I therefore propose to place the facts on record.

In Kathiawar the monsoons are not heavy: here in Bhavnagar our average annual rainfall is about 22 inches. Nevertheless I noticed last year that *T. læta*, common in the hot weather, disappeared about the second week of June, before the burst of the monsoon, and did not re-appear until the middle of September. *T. venata*, on the other hand, made its first appearance just before the first rains at the end of June and continued on the wing until the end of September, after which there were no more seen until the following rains.

My interest in Bell's suggestion was aroused and I maintained a look-out for an ovipositing female of either form. Patience was rewarded on August 1 this year when I caught a *venata* female in the act of laying an egg on a leaf of a small semi-trailing plant since identified as *Cassia pumila*, a near relation of *C. kleinii*, the food-plant of *T. libythea*. On this occasion I obtained three eggs, all of which hatched on the fourth day after being laid. Of the three larvæ, one only survived to maturity, producing a normal male of *T. venata*.

So far I had done no more than discover the food-plant and larva of *T. venata*, but this was an important initial step. It was on

September 10 that I found more eggs and some half grown larvæ on the same plant. I could detect no difference between them and those of the original *venata* batch of August. From these larvæ, in due course, I bred seven butterflies, all typical *læta*, the first of which emerged on September 19. Meanwhile I had taken the first, a perfectly fresh specimen of *T. læta* on the wing on September 17. *T. venata* was still fairly common at this date but had disappeared and *læta* become common by the end of the month.

Now, as to the larvæ and pupæ. Unfortunately I am not expert enough to give a thorough scientific description. But both larva and pupa in each case closely resembled that of *T. hecabe*, with the following differences in each case :—

LARVA—

(*a*) Possession of a dorsal line darker than the ground colour, as in Bell's description of the larva of *T. libythea.*

(*b*) Above the yellowish-white lateral line is a definite though not distinctly marked line of darker green than the ground colour—this line apparently does not exist in *T. libythea.*

PUPÆ—

No. 1. In shape very like *hecabe*, but smaller. Colour green, not shiny. A whitish dorsal line. Spiracles white. Two subdorsal rows of dark brown double spots like a horizontal colon, the spots in the upper row placed obliquely, in the lower row longitudinally and more pronounced. A somewhat diffuse brownish lateral line with a brown patch on segment seven and a fainter one behind the antennæ. Faint brown markings on wings. Distinct black specks between ends of veins on termen. Snout brownish-pink.

No 2. Dark markings much accentuated, the upper sub-dorsal row containing three instead of two obliquely placed spots in each segment.

No. 3. Markings less distinct, upper dorsal row of spots obsolescent.

No. 4. Brown and black markings almost obsolete.

The four pupæ above described all produced the *læta* form.

No. 5. Which produced the *venata* imago, was almost devoid of markings, except for traces of the dorsal and lateral lines and the pinkish brown snout, thus resembling No. 4 (*læta*). Had this specimen had more pronounced markings it might have finally solved the problem.

As I have said the evidence cannot be considered absolutely conclusive, but I would invite attention to the following considerations. If the September larvæ hatched from eggs laid by a *læta* female, they must have been deposited not later than the middle of June. I was looking out for either form and am as nearly certain as it is possible to be that there were no specimens of *læta* on the wing after the third week in June and before the break of the monsoon. The *venata* eggs hatched within four days of being laid. Like them, the early September eggs were all laid on the upper sides of leaves which appeared of recent growth and which I do not believe could have been in existence before the rains commenced. Moreover I believe it to be a fact that when the oval stage is prolonged a butterfly's eggs are never laid on leaves but on the stems of a plant. Again, if the two species are distinct, then the *venata* brood which appears at the end of June must have passed a period of eight or nine months in either the oval or the pupal stage. This is perhaps not impossible but seems most unlikely, in the climate of Kathiawar, in the case of a small insect which, in August, spends no more than ten days in either of these stages and whose nearest relations are on the wing and therefore, presumably, produce brood after brood during the whole of the dry season from October to June.

Practically no doubt remains in my own mind that *venata* and *læta* are seasonal forms of the same butterfly, but I should be glad to know what Mr. Bell thinks of the evidence. In any case, now that the food plant is known, it should be possible to place the matter beyond doubt before long.

In this connection, I wonder if Mr. Bell could find time to give us an article on the breeding of Lepidoptera in India? I entirely failed in my attempts to induce *Terias* females to lay eggs in captivity.

There is one other point, by the way, which in this district brings *læta* and *venata* closer together in respect of colouring. Evans, in his key to the genus *Terias*, gives the following characteristics of *venata*, apart from the rounded apex as distinguishing it from *læta* :—

'Upf marginal band reaches dorsum. Uph black margin to V 1 or farther.'

Now, in Bhavnagar, I find that, in females of the first *venata* brood, appearing end of June, this does not hold good; for some specimens, while possessing the rounded apex and being covered with minute black scales, otherwise resemble *læta* in that the uph marginal band ends at V 2 and the uph black margin consists of merely a diffused patch at apex. Apart from shape the invariable differences consist in the uph margin in male *venata* and in the typical colouring and markings of the underside of *læta*.

Finally, surely the illustrations of Fig. 70 in Plate K of *The Common Butterflies of the Plains*, vol. xxii, represent *libythea* and not *venata?* Note the undiminished extension of uph black margin right on to the dorsum and the markings of the underside.

BHAVNAGAR, A. H. E. MOSSE, I.A.,
December, 1928. *Lieut.-Colonel.*

Mr. T. R. D. Bell, C.I.E., commenting on the above note under date May 1, 1929 writes :—

Colonel Mosse's note on *Terias venata-laeta*. Are they the same species ?. The foodplant offered no difficulty in settling the question with me down here as I knew both species will feed, as caterpillars, on the same *Cassia kleinii*. It was really the want of enthusiasm (?), time or energy that prevented me finding out definitely whether the two forms are seasonal or constitute good species. It is only a matter of collecting eggs at the beginning or end of the rains, enough eggs ; and that means watching females laying and collecting the very eggs laid together with the female that lays them or the females that lay them, a rather lengthy and monotonous proceeding ; one might of course have luck and be able to do the thing in a single day but, in my case, I never did have any luck and was never able to get more than one or two females a day that obliged me by laying at all. If the beasts would lay in captivity it would greatly facilitate matters but apparently they are unwilling to do so. Any way I have never succeeded in getting them to lay in cages though I have tried twice or thrice. And, apparently, Colonel Mosse, now, has had a similar experience. At the same time I have little doubt that with perseverance one could get them to lay all right. One of the chief difficulties is the foodplants (there are several species) which is very deep-rooted, that is, has a strong, long, hefty taproot and is, therefore, very difficult to keep properly in a cage. The little leaflets all close up immediately the plant is (practically) touched and butterflies that lay on the upper surface of leaflets or leaves, wont lay on the under surface, so that too goes against ovipositing in captivity. I fancy the best way to do things would be to go and camp where the plants (and the butterflies) are to be found (damp fields generally, or damp grasslands), catch paired females (that is often not at all difficult) and, having covered a certain number of the naturally-growing plants with a mosquito-netted frame, put the insects inside and await results : You see it means a lot of bandobast and none of us have time, or inclination, or opportunity.

I do not think Colonel Mosse's experiences are conclusive in any way more than my original observations were. If he were quite sure that no læta were to be found in the rains and no venata in the rest of the year, it would be all right ; but he is not ; neither am I ; although both of us are nearly certain that such is the case. But we are not absolutely certain. And, there is another thing as well and that is that læta may well last a great deal further into June and July in an open, dry country than it would in a moist, jungle-covered region. I do not think we shall ever get anything satisfactory out of the problem until we actually succeeded in breeding a venata from a læta or the other way round. I have described caterpillars of both species and have not been able to detect any differences in them or in their pupæ.

I hope you will publish Colonel Mosse's article ; it will perhaps attract the attention of some enthusiast who might spend enough time on the question to settle it once for all—by breeding one form from the other.'

T. R. BELL.

XLI.—ANTS TAKING TO WATER

The following ant incident which occurred at Lucknow may be of sufficient interest for inclusion in Miscellaneous Notes of the Journal. Last autumn I had some rather sweet hairwash on my wash stand; the day after I had opened it I found it covered with small dark brown ants ⅛ inch long. I cleared all these ants off and thinking no more about it, placed the bottle in my soap dish full of water, the sides of the bottle were about one inch from the outer edge of the soap dish. Next morning to my surprise I found the bottle again covered with ants. I then watched carefully and soon saw several ants 'take off' from the edge of the soap dish and swim across to the bottle and carry on, others again left the bottle swam to the edge of the soap dish. To carry out further experiments I placed the bottle in the middle of my basin, *after clearing all ants off the bottle.* I put in absolutely fresh water at about 9 a.m. and at 2 p.m. I had a look and found the bottle again with ants on it, not many of them but there they were, and while I watched I saw several deliberately 'take off' again from the edge of the basin and swim *absolutely straight* for the bottle. I got a magnifying glass on to them and saw that they gathered an *air-bubble* under them before taking off. There was absolutely no film of dust or anything like that on the surface of the water.

I think readers will agree it was a remarkable performance for these ants to do this, as apart from the actual swimming performance, everyone know how ants wander about in every direction when by themselves, whereas these all made a bee line for the bottle and back, and there were never more than one on the water at the same time. They had nothing to guide their sense of direction. The distance they had to swim across was about 4½ inches.

JAMRUD, N.W.F.P. W. M. LOGAN HOME,
April 26, 1929. *Major, I.A.*

XLII.—A NOTE ON THE OCCURRENCE OF BUDS IN THE AXILS OF THE COTYLEDONS

(*With two plates*)

The presence of buds in the axils of the cotyledons, and the development of shoots from them, so far as I am aware, has not yet been described. It appeared, therefore, desirable that the following observations should be recorded:—

It was while examining once the seedlings of *Cassia tora* that the attention of the writer was drawn to the existence of such buds. In one of the plants, while at the height of its vegetative activity, shoots were seen developing from the axils of the cotyledons. The plant had not suffered from any injury, and was otherwise in a perfectly healthy condition. Cases of this kind, however, in which the shoots begin to develop from the cotyledonary buds without injury, at an early stage, to the primary shoot, are not generally met with. But it was found that whenever the plant was decapitated close to the cotyledons, whether in the seedling condition or a little later, these shoots invariably developed in due course.

Another interesting feature that was noticed was that the epigeal cotyledons remained green and functional for an unusually long period of time, instead of dropping away, as they usually do, when the seedling has established itself. For instance, in this particular case the plant was in vigorous condition of growth, and was about to enter into the reproductive phase, but still the cotyledons were thriving and there was nothing to indicate that they would cease to do so. Unfortunately the plant was accidentally removed before the observations were complete.

My attention was later drawn to the occurrence of axillary buds in the cotyledons of *Cicer arietinum.*[1] Here too, as in the case of *Cassia tora*, shoots had developed out from the axils ot the cotyledons, while the primary shoot was uninjured. But in this species also as before, such cases are not generally met with, and the axillary shoots only begin to develop on the destruction of the primary axis close to its origin.

Since observing these cases the writer was led, out of mere curiosity, to determine whether similar behaviour is revealed by the seedlings of other plants. As the result of observations he has now found that the seedlings of the following plants exhibit identical behaviour :—

Impatience balsamina ; *Vicia faba* ; *Tropæolum majus* ; *Ricinus communis* and some others. From this there appears to be little doubt that this phenomenon will be found to be of general occurrence.

DEPARTMENT OF BOTANY, N. K. TIWARY, M.SC.
BENARES HINDU UNIVERSITY.

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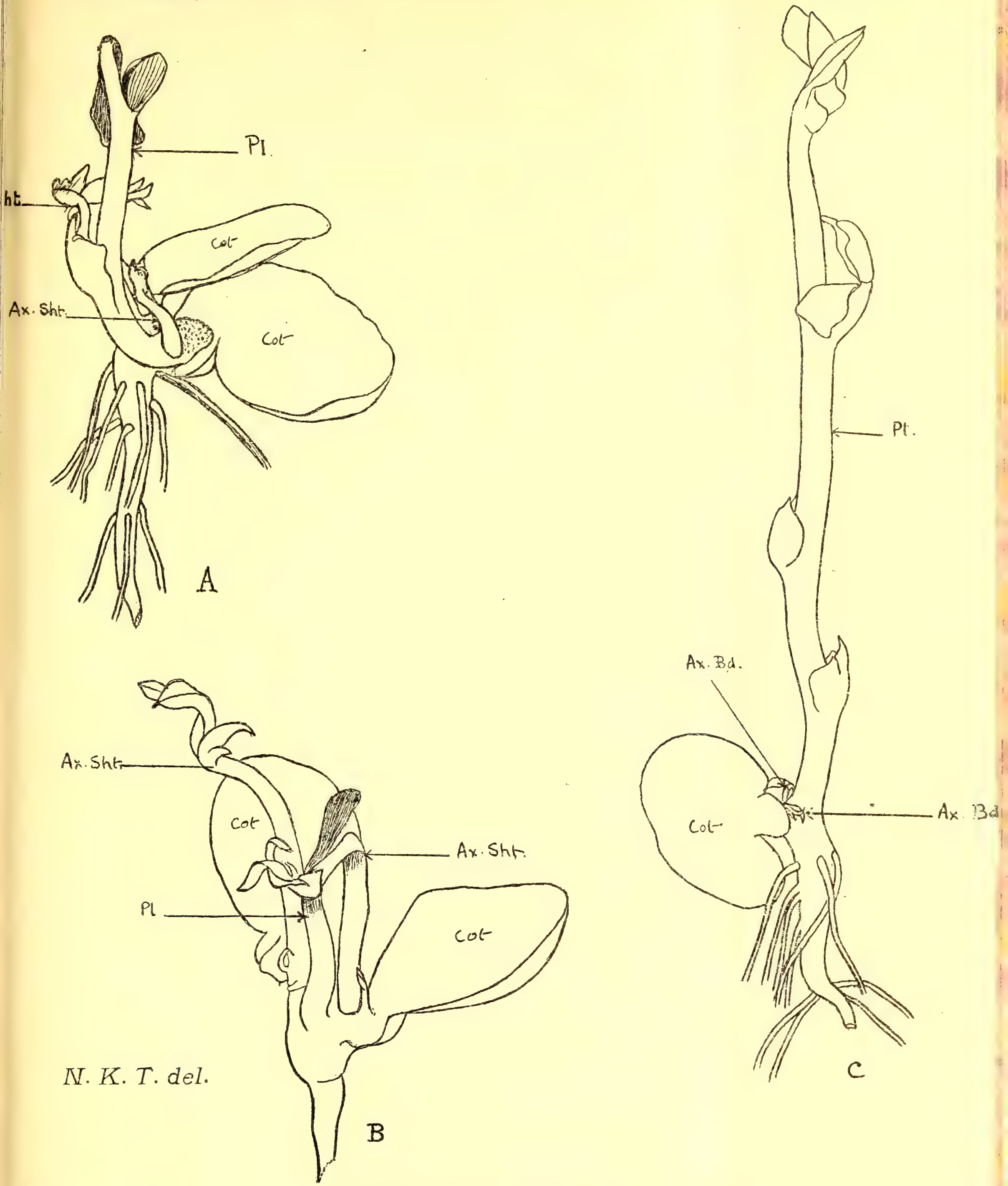
[1] For this I am obliged to my former pupil Thakur Chandra Narain Singh M.SC., now on the staff of the Department of Plant Industry, Indore.


Pl.
ht
Cot
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Ax. Sht.
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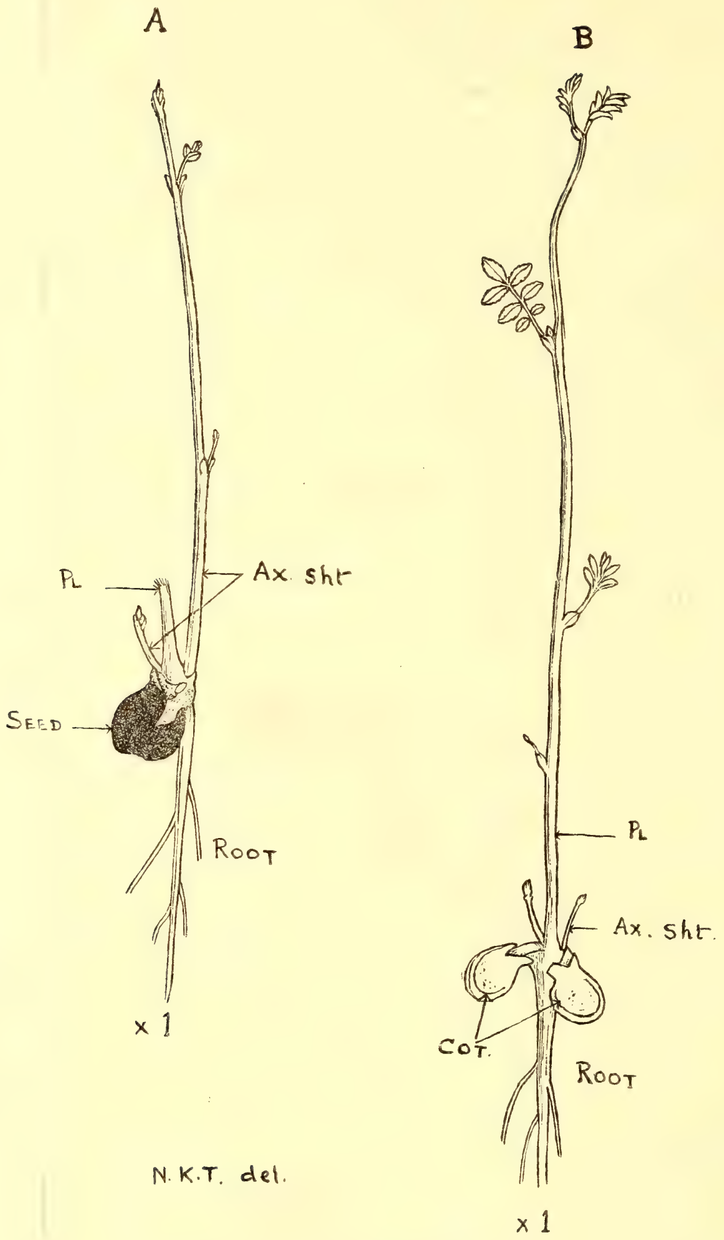
Pl.
Ax. Bd.
Ax. Bd
Cot
C

AXILLARY BUDS IN COTYLEDONS.

Seedlings of Vicia faba ; natural size.
A and B—Seedlings in which the plumule had been injured.
C—Healthy seedling.
Pl—Plumule ; Ax. sht—Axillary shoot ; Cot—Cotyledon ; Ax. Bd—Axillary bud


A
B
Pl
Ax. sht
Seed
Root
x 1
N. K. T. del.
Pl
Ax. sht.
Cot.
Root
x 1

AXILLARY BUDS IN COTYLEDONS.

Seedlings of Cicer arietinum.
A—Seedling whose plumule had been injured.
B—Healthy seedling.
Pl—Plumule; Ax. sht.—Axillary shoot; Cot—Cotyledon.

AN APPEAL TO SPORTSMEN

BY

R. I. Pocock, F. R. S.

(*British Museum Natural History.*)

Wanted ! The Skins and Skulls of Tigers, Panthers, Bears, etc.

Readers of this Journal, interested in the Mammal Survey of British India, inaugurated and carried to such a successful issue by the Bombay Natural History Society, will be aware that the collectors whose services were requisitioned for the purpose received general instructions to devote their energies to the capture of the ' smaller fry ', which might be classified as vermin, and to neglect ' game ' animals so as not to trespass upon the province of the sportsman. The success of the survey along the lines indicated is attested by the numerous reports and papers on the results published in the Journal during the past fifteen or sixteen years. So great indeed were the additions to our knowledge that need for a new edition of the Mammals of the *Fauna of British India Series* became apparent and urgent. This volume is now in progress ; but at the very outset the authors are confronted with the difficulty arising from the dearth of material of ' big game.' There are, for example, only about a dozen skins of tigers and a few more of panthers and not a single specimen of the Himalayan red bear in the National Collection !

The purpose of this note is to appeal to sportsmen in the first place for the skins and skulls of tigers, panthers and bears, leaving antelope and deer for the moment alone. It is of course quite understood that the skins of tigers and panthers, and in a lesser degree, the skulls, are treasured trophies. But it is felt that a number of these beasts must be shot which are not wanted or not preserved, more particularly perhaps those killed by Indians, for the reward, which would naturally not appeal in the same way to the sportsman as those falling to his own gun. Many also must be killed which are not considered worth preservation as rugs on account of defects in the coat due to old age or sickness. It must also be explained that from the naturalist's standpoint small tigers and panthers, adult or immature, are just as interesting as those which sportsmen preserve for their size. All the spoils indeed of these beasts that can be spared will be most acceptable to the National Collection in the British Museum, which, doubtless largely from want of asking, has a comparatively very poor series of these predatory beasts.

Some sportsmen perhaps may exclaim in response to this neglect :—' Since a tiger is a tiger and a panther a panther wherever you meet him, what purpose is served by amassing a big collection of them?' That is the view that prevailed half a century ago. But in these days intensive study of the smaller mammals has shown, by means of big series of skins from many localities, that species vary in size, colour and other characters according to their environment. This is known to hold to a great extent in the case of tigers and panthers. What is wanted is a collection, available at any time to all interested in the subject, showing, for instance, that the tigers and panthers from Cape Comorin, the Sunderbunds, Nepal and Rajputana differ, or, may be do not differ from each other; and what applies to India applies equally to the Malay Peninsula, Burma, China, Persia, to all places indeed where these animals are found.

If the facts we wish to know are ever to be known, no time should be lost, because in many districts where these animals, and particularly tigers, were formerly abundant they are now quite rare. It must be remembered that of the lions recorded as shot in Bengal a century ago none remains and no spoils, so far as is known, are preserved; and that the hunting leopard or cheetah seems to be fast disappearing from the Indian fauna. Of these two species, so far as India is concerned, the British Museum has practically no material; and the expectation of getting any is, I fear, now well nigh hopeless.

It is true the Indian lion still occurs in small numbers in the forest of Gir, Western India, where fortunately it is protected. The National Collection does not possess a specimen of this lion—and if it is possible to obtain one, it would be a valuable acquisition for the British Museum (Natural History).

But it is not yet too late to acquire tigers and panthers; and the hope that some sportsmen will generously help, induces me to make this appeal.

With regard to bears, mentioned above, it is the Himalayan 'red' or 'isabelline' bear, the Indian representative of the Russian brown bear, that is particularly required, although the commoner Indian and Burmese species are also desiderata. Wolves too and hyenas are wanted, more particularly wolves to help clear up some puzzling points connected with the kinship between the small wolf of the plains (*C. pallipes*), the Himalayan wolf (*C. chanco*) and the European wolf (*C. lupus*).

In making this petition on behalf of the National Collection, I am aware that I am asking much, knowing the value sportsmen naturally set upon skins and the time and labour involved in taking and recording separate measurements in the flesh of the head and body and the tail, stripping the skin, roughly cleaning the skull, recording the locality, altitude and date, packing and despatching. But I am assured that the Bombay Natural History Society, which has always been consistently helpful in the past, will in this instance continue its kind offices and forward to London any specimens sent to them marked *For the British Museum*.

ANSWERS TO CORRESPONDENTS

R.S.K.—*I read a reference in the Press to Huxley's Bathybius; can you tell me something about it?*

The story of *Bathybius* is a classic demonstration of the fallacy of scientific theory-making on the strength of insufficient data. The great stir caused in the scientific world by the Darwinian researches in the middle of the last century, produced feverish activity and much premature cocksuredness among men of science to discover the origin of life, regarding which numerous and elaborate theories had come to the fore. The obvious beginning for an enquiry of this nature demanded at the outset the isolation of the simplest living organism; in other words, a connecting link between the simplest known (though still comparatively highly organized) Amoeba on the one hand, and what we call lifeless matter on the other.

All eyes were turned to the abyssal ocean depths which it was hoped would ultimately furnish a clue, and a number of expeditions were put out by almost all the maritime countries of Europe for investigation in this field. One of these expeditions dredged up mud from the bottom of the Atlantic which, when preserved in alcohol, revealed the presence of a quantity of soft gelatinous matter. A noted scientist of the day, Prof. Wyville Thomson, was not long in pronouncing that given certain stimulus, distinct traces of movement were discernible in this matter, a revelation which he asserted left no doubt that the substance manifested the phenomena of a very simple form of life.

The 'discovery' startled the scientific world and was hailed with acclamation by ardent Darwinians like Huxley in Great Britain (who promptly christened the slime *Bathybius haeckelii*) and Haeckel in Germany, and indeed for a time the prospect of running to earth the elusive missing link between the living and non-living appeared assured. The sensation which this 'discovery' caused in scientific circles soon led to more intensive investigation on the same lines with a view to the final elucidation of that problem of problems, the Origin of Life, which had been apparently brought within realization by the advent of *Bathybius*.

The gelatinous matter though again brought up in quantity from great depths while cruising between China and Japan, by the investigation ship 'Challenger' in 1872, completely failed to show any signs of the movements described by Wyville Thomson, despite continuous observation. After much experimenting, it was finally discovered by the senior chemist on board, Mr. Y. J. Buchanan in 1875, that in reality *Bathybius* was not an organic body at all but, according to him, 'sulphate of lime which had been eliminated from the sea water, always present in the mud as an amorphous precipitate, on the addition of spirits of wine. The substance when analysed consisted of sulphuric acid and lime; and when dissolved in water and the solution allowed to evaporate, it crystallized in the well-known form of gypsum, the crystals being all alike and there being no amorphous matter amongst them'.

Subsequent to this announcement the professor of Chemistry at the Edinburgh University was able to demonstrate the truth of Mr. Buchanan's observations by manufacturing *Bathybius* in his own laboratory !

Thus died rather abruptly the high hopes and confidence that had sprung in the bosoms of scientists for the speedy solution of that most vexed problem, the Origin of Life.

P.R.L. *A friend recently bred a large moth in a prune Jar with a mosquito net covering. A few hours after the emergence of the insect it was visited by six or seven other moths of apparently the same species. Can you explain the meaning of this attraction. We have never seen these moths in our neighbourhood.*

The moth bred was a female and the visitors were males in the rôle of would-be suitors. The phenomenon has often been observed. A female Tussar Silk moth was recently bred in the Society's rooms. The insect emerged at night. In the morning we discovered three males of the species in the vicinity of her cage. How far these males had travelled in search of a mate we are unable to conjecture but these moths are certainly rarely seen in our city. The power that certain moths have of sensing the presence of a female from apparently considerable distances is attributed to their sense of smell. There is no other sense of which we have any knowledge which can explain it. The fact that this attractability is lost when the female is imprisoned in a more or less air-tight container lends colour to the theory. Again it has been shown that in the absence of the female the box or cage which recently enclosed her may hold the same power of attracting the males of her species. This suggests plainly the existence of some material emanation which can be perceived by her would-be suitors. The presence of other smells does not appear to effect this sense in moths and it is believed that these insects only perceive the particular odours which are vital to their being, that is odours which suggest food or a mate. The perception of odours may be regarded as a chemical action. Infinitely small particles of the substance, probably in the form of a gas, permeate the air and coming into contact with the sense organ, produce an effect recorded by the brain, which can distinguish between the stimuli of different substances. What astonishes us is that the scent of the female is perceptible to the males at such remarkable distances ; that it effects so great an extent of atmosphere. In explanation it is suggested that the scent in question is not perceptible to our senses. We have therefore no means of guaging its real strength. We know for instance that even an extremely small quantity of musk will scent a room for long periods of time without suffering any appreciable loss in weight. If so small a quantity of musk can make the presence of its particles felt in the circulating air of a room for months and even years, there seems no difficulty in supposing that the Moth's scent, probably infinitely more volatile, can, for a short time, fill the air for hundreds of yards or even for miles around. The error seems to lie in the idea that because we cannot perceive the scent it must of necessity be very weak whereas it may be, and doubtless is, extremely strong.

REPORT OF THE COMMITTEE OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING DECEMBER 31, 1928

The Committee of the Bombay Natural History Society have the honour to submit their Report on the operations and progress of the Society for the year ending December 31, 1928.

Important changes were made in the constitution of the Society during the year under review.

Administration.—At an Extraordinary General Meeting held at the Prince of Wales' Museum on Tuesday, January 31, 1928, the draft Memorandum of Association and Rules which were laid before the Meeting and which had been previously published in the Society's Journal on October 20, 1927, were approved, and the following gentlemen were duly elected to serve on the Executive and Advisory Committee of the Society.

President: H. E. The Right Hon'ble Lt.-Col. Sir Leslie Wilson, P.C., G.C.I.E., C.M.G., D.S.O.

Vice-Presidents: H. H. The Maharao of Cutch, G.C.S.I., G.C.I.E.; Revd. E. Blatter, S.J., Ph. D., F.L.S. and the Hon'ble Mr. J. E. B. Hotson, C.S.I., O.B.E., I.C.S.

Executive Committee:—Mr. R. D. Bell, C.I.E., I.C.S.; Mr. H. A. W. Brent; Prof. V. N. Hate, B.Sc.; Mr. P. M. D. Sanderson.; Lt.-Col. F. P. Mackie, I.M.S.; Mr. A. M. Todd.; Mr. J. B. Greaves (*Honorary Treasurer*) and Sir Reginald Spence, Kt. (*Honorary Secretary*).

Advisory Committee:—Mr. T. Bainbrigge Fletcher, F.E.S. (Pusa); Mr. T. R. Bell, C.I.E., I.F.S. (Retd.) (Karwar); Brigadier W. H. Evans, C.I.E., R.E. (Peshawar); Lt.-Col. F. C. Fraser, I.M.S. (Vizagapatam); Dr. F. H. Gravely, D.Sc. (Madras); Mr. C. M. Inglis, M.B.O.U., C.M.Z.S. (Darjeeling); Lt.-Col. R. B. Seymour Sewell, I.M.S. (Calcutta).

Arrangements for the Registration of the Society and the transfer to it of all the property and assets, including securities and cash, belonging to the unregistered Society were completed by Sir Reginald Spence, Mr. H. A. W. Brent and Mr. J. B. Greaves who were authorized by the Meeting to carry them into effect and a Certificate of Registration, dated March 14, 1928 was received from the Registrar of Companies. A Report of the Extraordinary General Meeting and of the various amendments to the draft of the Rules and Regulations of the Society was published in the Society's Journal issued on May 31, 1928.

Finance:—The publication for the first time last year of a Balance Sheet has enabled us to do away with the Summarized Cash Account and the Ordinary Receipts and Expenditure Accounts, producing in their place a simple Revenue Account and Publications Account along the lines of a Profit and Loss statement.

Dealing first of all with the *Revenue Account*:—The figures on the expense side remain very similar to what they were last year.

On the receipts side—Life Membership Fees Rs. 2,450 as against Rs. 4,200.

Entrance Fees Rs. 1,644-8-0 as against Rs. 2,980-0-0.

Subscriptions Rs. 28,556-1-9 as against Rs. 28,711-8-10.

The Taxidermy Department has been placed on a paying basis and has resulted in a small profit to the Society of Rs. 63-1-2.

The total loss on Revenue Account is Rs. 4,682-3-0.

Publications Account:—Shows a satisfactory profit of Rs. 3,053-10-10 although a considerable proportion of the expense in connection with these publications has been dealt with in previous years.

Dealing now with the *Balance Sheet*:—The Balance Sheet discloses an extremely satisfactory position.

The Assets side is self-explanatory with the possible exception of the heading 'Game Books'. Last year we created a reserve equal to the total value of the Game Books in stock. A number of the Game Books have been sold and in consequence there is a balance of Rs. 2,847-8-0 to be transferred back to the surplus assets account.

Liabilities :—Life Membership fees remain at the same figure ; those paid in during the year having been appropriated for General Revenue purposes as it is considered that the figure of Rs. 42,000 represents an ample reserve against Life Membership Fees.

Under our Articles all that is necessary to be done is to maintain Government paper investments up to the total value of Life Membership Fees. Our Investments in Government Paper total Rs. 76,270 as against fees received from present Life Members amounting to Rs. 42,000.

Donations for specific objects unexpended :—The Society is holding this money as a Trustee.

Surplus Assets :—To last year's balance have to be *added* the profit on publications and the profit on Game Books sales, and to be *deducted* the sum of Rs. 2,092-8-0 being depreciation on our Securities. In no case have any Securities been written up and the depreciation is merely a routine one, to bring our 3½ per cent Securities down to market value on December 31, 1928, the actual value of our Securities being considerably above the figure shown.

Also to be *deducted* is the loss on Revenue Account.

The nett difference therefore in the Society's position between last year and this year is a loss of Rs. 873-8-2 which appears to be a not unsatisfactory result.

Membership:—During the year, 83 new members joined the Society, 4 rejoined and 103 resigned. The total membership on December 31, 1928, was 1,392 including 190 Life Members.

The Society's Journal.—The 32nd volume of the Journal was completed and the first number of the 33rd volume was issued during the year. The Scientific contributions included :—Mr. Pocock's important paper on the Langurs. The author's conclusions regarding the number of different Langurs occurring and the importance of the differences between them vary considerably from previous authorities who have dealt with the subject. The material in the British Museum collections and particularly the large series of specimens obtained during the Society's Mammal Survey have enabled Mr. Pocock to find evidence which divides the Langurs into three groups sharply distinguished by the colours of the new-born young. Papers on birds included ' Birds of the Peshawar District ' by Rev. F. S. Briggs and B. B. Osmaston, ' Further Notes on the Birds round Simla ' and ' The Migration of the Pied Crested Cuckoo ' by H. Whistler.

Two papers on Indian Marine Fishes by Mr. H. Fowler of the Academy of Sciences, Philadelphia, dealt with fishes collected on the Bombay and Ceylon coasts and in addition to general notes, described three new species. Major Fraser continued his serial on Indian Dragonflies, Parts XXIX, XXX, XXXI of which were published during the year. Several botanical papers were issued ; the most important was the Revision of the Flora of the Bombay Presidency by Rev. Fr. Blatter. Since Cooke's Flora was published in 1900, a number of monographs dealing with various orders and genera have appeared and these and the study of systematic botany during the last 28 years have made the present revision necessary.

Popular Articles.—Mr. E. C. Stuart Baker continued his articles on Indian Wading Birds which form a supplement to the serials on Indian Game Birds of which Volumes I and II have already appeared in book form. A recent feature, introduced particularly for the benefit of members anxious to interest themselves in and take up as a hobby a particular branch of Natural History are the papers by Mr. H. Whistler on the ' Study of Indian Birds ' and by Mr. C. McCann on the ' Study of Plant Life.' It is hoped to extend this series so as to include other divisions of Natural History.

Parts I, II and III of Mr. Prater's articles on ' Modern Museum Methods ' were published during the year. The papers were based on his recent study of Museums in America and Europe. Copies have been sent to several Museums in this country and abroad.

Forthcoming Publications in the Journal.—For many years a popular illustrated book dealing with the commoner flowering trees of India has been a greatly felt want. The serial dealing with the conspicuous flowering Trees of India shortly to be published in the Journal, which utilizes flower paintings procured by Mr. W. S. Millard when in India and in the writing of which he is collaborating with Father Blatter, will it is hoped fill this want and eventually appear in book form.

Birds of Burma, by P. F. Wickham.—This is to be written on the lines of Mr. H. Whistler's *Popular Handbook on Indian Birds* and will it is hoped do for residents in Burma what Mr. Whistler has done for bird lovers in India.

Flowerless Plants, by Mrs. Robinson.—This will deal in simple language with Sea Weeds, Fungi, Ferns and Lichens and so with the little known, though nonetheless interesting, forms of plant life. It will be illustrated in colour and black and white.

Forthcoming Publications in book form.—Indian Game Birds, Volume III. This volume will deal with the Pheasants, Jungle Fowl and Spur Fowl and it is hoped to publish it next cold weather. Publication has been made possible by the keener interest taken recently by members in the first two volumes with the result that the Society should be clear of debt on the first two volumes this year. A greater demand is necessary however if the author and the Society are to realize any profit at all out of their labours. Publication of the third volume depends also on the number of orders registered before we instruct our printers to proceed. In the Journal published in January 1928 (No. 3, Vol. XXXIII) we asked members to register their names for the third volume and to say whether they would order it as a bound volume or in parts. On February 1, 1929 we had received 133 promises to buy Volume III as a bound volume. A better response than this is necessary if we are to proceed with publication. It is intended not only to revise the matter already published in the Journal but to issue more plates—coloured and uncoloured.

Bird Charts.—Although the Bombay Government has for financial reasons had to close down the work the Society was doing to encourage in schools the study of zoology—it, as well as other local Governments in India, recognizes the need of such work as students at present commence the study of zoology and botany only when they enter universities. Most of the Provincial Governments have therefore approved the proposals of the Society to issue a series of wall charts illustrating in colour no less than 200 common Indian birds, and schools in different parts of India have been advised to purchase the charts, at a cost of Rs. 36 for the series, as soon as published which it is hoped will be in September this year.

The publication of the Bird Charts will enable the Society to issue early next year an illustrated book on the common birds of India. The format will follow that of *The Book of Birds* published by the American Geographical Society and in addition to coloured illustrations and photographs will contain short descriptions of field characteristics and habitat.

Publications in book form issued during 1928. Identification of Indian Butterflies.—The profusely illustrated series of articles on Indian Butterflies by Col. W. H. Evans were issued in book form. There was a good demand for the book which is evidence of the interest created by the articles. The edition was practically sold out within a few months of publication.

Poisonous Terrestrial Snakes of India.—A fourth edition of this important book by Col. F. Wall was published during the year. The present edition is revised and brought up to date and improved by the addition of several new and better text figures.

Expeditions and Researches. Mammal Survey of the Toungoo District, Burma.—Since the closing down of the Mammal Survey the Society has been dependent for collecting on the efforts of individual members. The principal worker in the field in 1928 was Mr. J. M. D. Mackenzie who during the past three years has been carrying on a Survey of the Mammals of the Toungoo District. A report on his collections was published in Volume XXXII, No. 3. Subsequent reports are pending. We take this opportunity of expressing to him the thanks of the Society.

Vernay-Faunthorpe Expedition.—The thanks of the Society are due to Mr. A. S. Vernay for the opportunity offered by him to the staff of the Society to obtain experience in the field of collecting material for the preparation of Museum Groups. In January 1928 Mr. Prater was invited to join the expedition brought out to India by Mr. Vernay to collect material and to paint backgrounds for a series of groups representing game animals of India obtained during the Vernay-Faunthorpe expedition. The groups are being erected in the American Museum of Natural History, New York.

Mr. K. B. Savardekar, the Society's Museum Artist, also accompanied the expedition. The expedition visited the Nepal Terai, Burma and later Mysore. Material for a group of Gaur and for a group of Tigers was collected in the Billigiri-rangan Hills, Mysore, where Mr. R. Morris, a member of the Society rendered great assistance to the party. In this area was also obtained the material and the background studies for a group illustrating life in a South Indian Forest which was completed and placed on exhibition in our museum during the year.

Admiral H. Lynes' Expedition in Gilgit.—Mr. V. S. LaPersonne, Assistant Curator of the Society, joined the expedition organized by Admiral H. Lynes, who, with Mr. H. Whistler and Mr. B. B. Osmaston, visited Kashmir in April 1928 for the purpose of collecting specimens and studying the bird life of the Province. Mr. LaPersonne travelled through Gilgit to the borders of Russian Turkestan. Notes and observations were made and about 500 specimens were collected by him in the areas visited.

Bird Migration in India.—A review of the progress of the Society's bird-ringing scheme organized with a view to studying the problems connected with the migration of birds in India was published in Volume XXXII, No. 2. About 5000 rings have been distributed and about forty members of the Society are now helping in the scheme. Out of 200 birds ringed by the Maharaja of Dhar in 1926 eight recoveries have been reported. These results are very encouraging. Several recoveries of the rings issued during the year by the Society have already been reported. It is confidently hoped that more members will co-operate in this useful work during the cold weather of 1929-30.

Toxicity of the venoms of Indian Scorpions.—We published in an editorial note in Volume XXXII, No. 2 of the Journal a brief summary of the plans and the purpose of the investigation into the toxicity of the venoms of Indian scorpions. This investigation was prompted by the reports of several deaths from scorpion sting in the C. P. Fr. Caius, who commenced his researches into the toxic properties of the venoms of Indian scorpions in 1912, has consented to resume the work on behalf of the Society. Live scorpions are now being collected and sent to the Society from all over India; our thanks are due for the co-operation with us of the Medical Departments of the Government of Bombay, Madras, Bengal, Punjab, Central Provinces, United Provinces, N.W.F.P., Assam and Burma. Varying quantities of venom were extracted from six different species during the year. As the amount obtained from individual specimens does not exceed a few milligrammes it is essential for our purpose that large numbers of scorpions should be collected. The co-operation of all who are able to assist by sending live scorpions to the Society is solicited.

Salt Licks.—As indicated in an Editorial note published in Volume XXXII, No. 2, the Society, with the help of the Rev. Father Caius of the Haffkine Institute, Parel, is carrying out an investigation into the chemical composition of Salt Licks. The purpose of the investigation is to discover the element in the earth which attracts animals to Salt Licks. Samples of Licks analyzed by Major Clive Newcomb contained none or very little trace of *Sodium chloride.* Father Caius is of opinion that the investigation may throw light on the practice of earth-eating by human beings. Members of the Society and of the Forest Departments in India and Burma are helping us by sending samples of earth from 'licks' for analysis. About sixty-five samples have been collected up to date.

Educational.—The Nature Study classes for local schools at the Prince of Wales' Museum, inaugurated by the Society in December 1926, were discontinued at the end of February 1928. The total number of lectures delivered by the Society's Guide Lecturer, Mr. Salim Ali, was 195. The number of schools who co-operated in the scheme was 21. The total number of children who attended the lectures was 6,200. The lectures were discontinued owing to the inability of the Bombay Government to provide a grant for the maintenance of a Guide Lecturer at the Museum. It is regretted that Government's action has compelled the Society to postpone indefinitely the training of teachers able to instruct the young in the study of Natural History. The work that was being done for the schools in Bombay involved a great deal of preliminary labour. The scheme was successfully launched and was receiving the enthusiastic support of schools in this city and gave promise of very great development. A detailed report of the work done in this connection was published in Volume XXXII, No. 2 of the Journal.

Extension of Museum Accommodation.—The most important development of the year was the appointment by the Trustees of a Sub-Committee to consider the question of increasing the existing accommodation in the Museum. As far as the Natural History Section is concerned, an insufficient provision of exhibition space has proved an obstacle to its proper development from its inception. The galleries it occupies at present are inadequate for its immediate requirements—setting aside the question of future expansion. The section now has a gallery for mammals and a gallery for birds—both overcrowded. Reptiles, Amphibians and Fishes are shown in a single gallery whereas at least two galleries are required for the suitable presentation of exhibits illustrative of these classes. The whole Invertebrate Section, inclusive of insects, is located in one gallery, part of which is reserved for a Section of Economic Botany. It should perhaps be stated that the inclusion of the Natural History Section in the present building, designed solely for Art and Archæology was a temporary expedient. It was always intended that Natural History should be accommodated in a separate wing.

Report of the Sub-Committee.—The Sub-Committee reported that both for the present and future requirements of the Museum an extension of accommodation was an urgent necessity. They were of opinion that no structural alteration to the present building could provide the extra space required. They believed that the most satisfactory solution would be to remove the whole of the Natural History exhibits from the present building to a new building, constructed on the most modern lines and to confine the existing building to exhibits of Art and Archæology. It was further recommended that the architectural design of the exterior of the new building should conform as closely as possible to that of the existing structure. As far as its interior was concerned, it should be on the lines of the preliminary plans prepared by the Curator of the Natural History Section. In conclusion the Sub-Committee proposed that, as a preliminary measure plans and estimates for the new wing may be prepared. The question of its construction could subsequently be considered as it depended among other factors on the restoration by Government of the annual grant to its original figure.

The Sub-Committee's report was laid before the Trustees at a meeting held on December 9, 1927. It was then resolved that the Sub-Committee's report should be adopted and that detailed plans and estimates for the proposed new buildings should be called for. The work of preparing the detailed plans and estimates was subsequently entrusted to Messrs. Gregson, Batley & King, Architects, Bombay.

PROCEEDINGS

The Annual General Meeting of the Members of the Society was held on Tuesday, March 26, 1929 at 6 p.m. in the Prince of Wales Museum, the Hon'ble Mr. J.E.B. Hotson, C.S.I., O.B.E., I.C.S. presiding.

The Honorary Secretary announced the election of 55 new members since the last meeting.

The report for 1928 printed on the foregoing pages was taken as read and ordered to be published in the Journal.

The office-bearers elected at the Extraordinary General Meeting held on January 31, 1928 were re-elected with the following exceptions and additions :

President.—H. E. The Right Hon'ble Sir Frederick Sykes, P.C., G.C.I.E., C.B.E., K.C.B., C.M.G. was elected in place of Sir Leslie Wilson, left India.

Executive Committee.—The following additional members were elected : Rev. Fr. F. Caius, S.J., Mr. Alwyn Ezra, F.R.G.S., Mr. J. G. Ridland, and Major S. S. Sokhey, I.M.S.

Advisory Committee.—Lt. Col. C.H. Stockley, O.B.E., D.S.O., M.C. (Fort Sandeman) was elected additional member.

The Honorary Treasurer, Mr. J. B. Greaves, then presented the accounts which are printed on pages 742 and 743 of this journal.

BOMBAY NATURAL HISTORY SOCIETY

BALANCE SHEET AS AT DECEMBER 31, 1928

LIABILITIES.	RS A P	RS A P	RS A P
Life Membership Fees			42,600 0 0
Donations for specific objects unexpended ...			8,195 12 2
Sundry creditors—			
Printers of Game Books		2,647 15 2	
,, Journal		7,000 0 0	
For Expenses		330 11 0	9,978 10 2
Surplus Assets—			
As per last Balance Sheet		38,116 14 4	
Add : Profits on Publication		3,053 10 10	
Game Book Sales		2,847 8 0	
		44,018 1 2	
Deduct—			
Investments depreciation ...	2,092 8 0		
Loss on Revenue Account ...	4,682 3 0	6,774 11 0	37,243 6 2
Total ...			98,017 12 6

ASSETS	RS A P	RS A P
Investments at par or market value whichever is lower.		
Rs. 28,000 Govt. 3½% Notes at 73% ...	20,440 0 0	
,, 10,000 ,, 4% 1916/17 Loan at 92%.	9,200 0 0	
,, 15,000 ,, 5% 1945/55 ,, at par.	15,000 0 0	
,, 8,000 Bom. Dev. 6½% 1935 ,, at ,,	8,000 0 0	
,, 14,000 Port Trust 4% Bonds at 82%.	11,480 0 0	
,, 15,000 Imp. ,, 4% , at 81%.	12,150 0 0	76,270 0 0
Cash—		
On Fixed Deposit with Banks	11,600 0 0	
With National Bank of India in Current Account	3,720 15 0	
,, ,, ,, £142-8-1 at 1/6*d*...	1,898 11 6	
On hand	150 0 0	17,369 10 6
Sundry Debtors		267 3 0
Furniture—		
As per last Balance Sheet	2,500 0 0	
Additions during year	275 0 0	
	2,775 0 0	
Less Depreciation	500 0 0	2,275 0 0
Publications Excluding Journal, At cost ...		700 0 0
Note.—Any Publications which have been on hand over 2 years have been written off.		
Bird Charts, expenditure to date ...		1,135 15 0
Game Books, at cost	65,520 10 8	
Less, realized to date	53,595 8 0	
	11,923 2 8	
Already written off as per last Balance Sheet	14,772 10 8	
Transferred to Surplus Assets A/C per contra	2,847 8 0	
Note.—50% of any profits to be paid to Authors.		
Note.—A stock of 17,500 old Journals and the valuable research collection and library of 2,400 volumes have not been taken into account on the asset side of the Balance Sheet.		
Total ...		98,017 12 6

We have prepared the above Balance Sheet from the cash book and from information given to us, and have verified the investments and Deposits.

In our opinion such Balance Sheet represents a true and correct view of the state of the Society's affairs according to the best of the information and the explanations given to us.

BOMBAY, *February 19, 1929.*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants, Auditors.

(Sd.) J. B. GREAVES,
Honorary Treasurer.

REVENUE ACCOUNT FOR THE YEAR ENDED DECEMBER 31, 1928

	RS A P	RS A P		RS A P	RS A P
To Salaries. Income Tax and Contribution to Provident Fund	23,827 8 0		By Life Membership Fees	2,450 0 0	
,, General Expenses	898 10 8		,, Entrance Fees	1,644 8 0	
,, Rent	2,436 0 0		,, Subscriptions	28,556 1 9	
,, Printing and Stationery	830 1 6		,, Taxidermy	63 1 2	
,, Postages	972 6 6		,, Interest	4,423 2 0	
,, Library	900 7 11		,, Loss	4,682 3 0	
,, Furniture Depreciation	500 0 0				41,818 15 11
,, Audit Fee	500 0 0				
,, Insurance	100 0 0				
,, Legal Expenses	1,078 2 0				
,, Film Editing	500 0 0				
,, Journal less sales and Advertisements...	9,275 11 4	41,818 15 11			
Total ...	...	41,818 15 11	Total ...	...	41,818 15 11

PUBLICATION ACCOUNT FOR THE YEAR ENDED DECEMBER 31, 1928

	RS A P	RS A P		RS A P	RS A P
To Printing of Society's Publications ...	350 0 0		By Sales—		
,, Balance	3,053 10 10	3,403 10 10	Snake Charts	1,551 4 0	
			Poisonous Snake Books	342 1 0	
			Society's Publications	1,133 14 3	
			Other matter	376 7 7	3,403 10 10
Total ...	...	3,403 10 10	Total ...	...	3,403 10 10

ACCOUNT FOR THE YEAR ENDED DECEMBER 31, 1928, OF INCOME AND EXPENDITURE OF DONATIONS FOR SPECIFIC PURPOSES

Prince of Wales' Museum, Nature Study and Fish Modelling

	RS A P	RS A P		RS A P	RS A P
To Expenditure on Show Cases, etc, ...	6,834 13 5		By Unexpended Balance as per last Account	7,968 10 7	
,, ,, ,, Fish Modelling ...	1,177 12 0		,, Donations	9,009 5 0	16,977 15 7
,, ,, ,, Nature Study ...	769 10 0	8,782 3 5			
,, Balance	...	8,195 12 2			
Total ...	...	16,977 15 7	Total ...	...	16,977 15 7

BOMBAY, *February 19, 1928.*
Examined and found correct.
(Sd.) A. F. FERGUSON & CO.,
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THE

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OF THE

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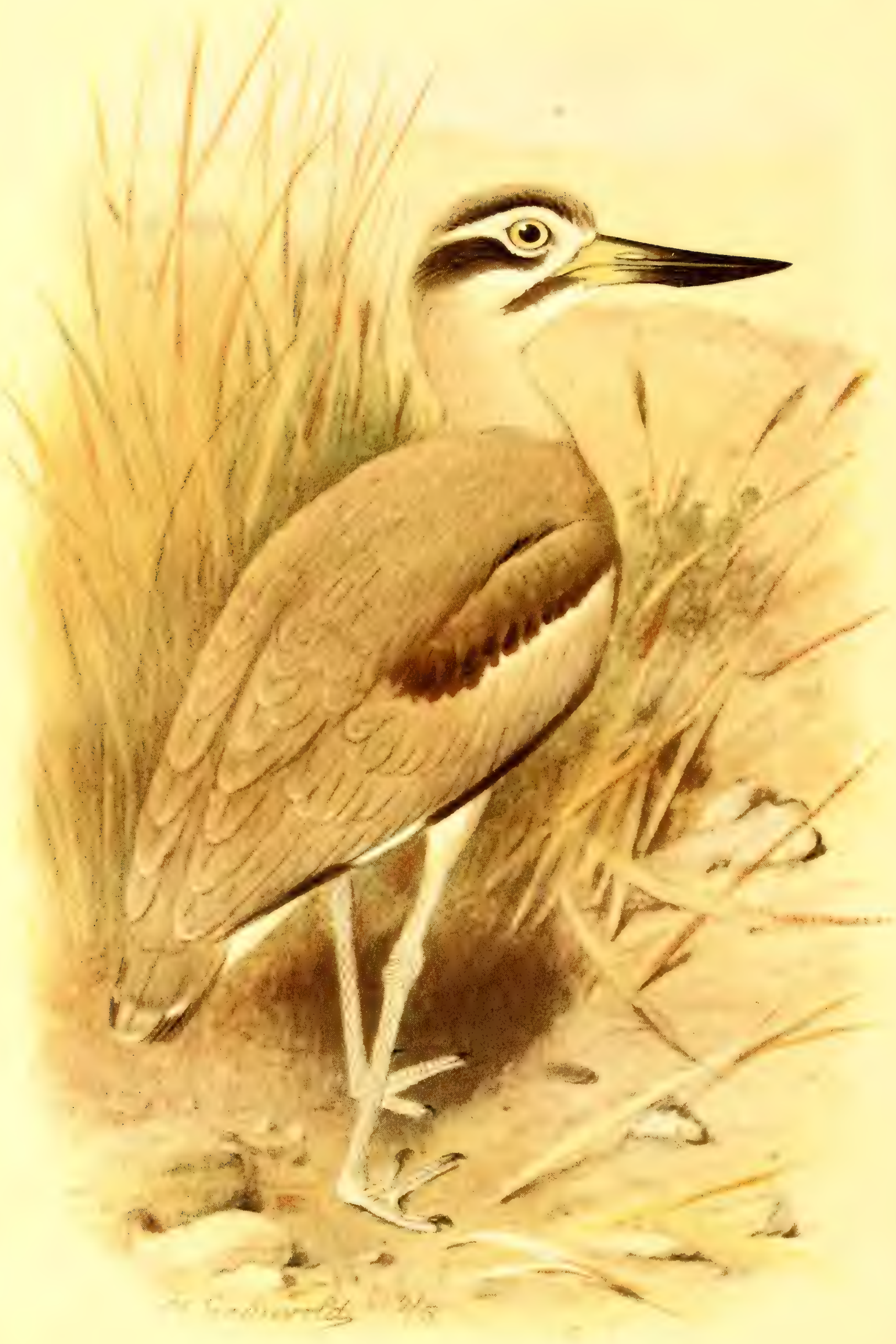

THE GREAT STONE-PLOVER.
Esacus recurvirostris.
$^2/_5$ Nat. size.

JOURNAL

OF THE

Bombay Natural History Society

OCTOBER 1929 VOL. XXXIII NO. 4

THE GAME BIRDS OF THE INDIAN EMPIRE

BY

E. C. STUART BAKER, F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

VOL. V

THE WADERS AND OTHER SEMI-SPORTING BIRDS

PART X

(*With a coloured plate*)

(*Continued from page 479 of this Volume*)

Suborder : OTI-LIMICOLÆ
Family : ŒDICNEMIDÆ
Genus : BURHINUS

Burhinus Illiger, Podr. Mam. et Aves, p. 150 (1811).

Burhinus œdicnemus

Charadrius œdicnemus Linn., Syst. Nat., 10th ed., p. 151 (1758) (England).

The typical form is larger and more buff than *B. œ. indicus* and darker than *B. œ. astutus*.

KEY TO SUBSPECIES

A. Smaller, wing 203 to 222 mm.; darker and more buff	*B. œ. indicus.*
B. Larger, wing 228 to 244 mm.; paler and less buff	*B. œ. astutus.*

BURHINUS ŒDICNEMUS INDICUS

The Indian Stone-Plover

Œdicnemus indicus salvadori—Atti Soc. Ital. Sci. Nat. vol. viii, p. 381 (1866) (India).

Œdicnemus scolopax.—Blanf. & Oates, vol. iv, p. 204 (part).

Vernacular Names.—*Karwanak*, *Barsiri* (Hin.); *Lambi* of Falconers; *Kharma* (Beng.); *Kaledu* (Tel.); *Kana musul* (Tam.).

Description.—Forehead, lores, a ring round the eye and a broad supercilium to the nape white; upper plumage ashy-brown, the feathers edged with buff or ashy-buff and with black central streaks, these are broad on the head, narrower on the nape and much broader again on the scapulars; lesser wing-coverts brown, edged rufous and with black subterminal bars; median wing-coverts white with brown or blackish terminal bars just edged with rufous or rufescent white, the basal white forming a distinct diagonal wing-bar; greater coverts dull white, with broad subterminal black bars; primaries black with a broad white patch on the middle of the two outermost, the other primaries with concealed white bases and the innermost with white tips also; innermost secondaries like the back; tail ashy-brown, tipped paler and with two irregular dark bars on the pale tips; outermost feathers white, with broad black tips and a faint dark band across the white of inner webs, other feathers grading from this to the central ones; sides of head white; the ear-coverts streaked with black; a black and rufous streaked line from the gape to the ear-coverts; chin and throat white; foreneck and upper breast pale buff, streaked with blackish-brown; under tail coverts pale buff; remainder of lower plumage white.

Colours of soft parts.—Iris bright yellow; bill black with a yellow base; legs and feet yellow or greenish yellow.

Measurements.—Total length about 400 mm; wing 203 to 222 mm.; tarsus 72 to 77 mm.; culmen 41 to 47 mm.

Young birds are paler, more marked with buff and have the streaks on the lower part narrower; the white wing-bar is not so distinct.

Nestling.—Sandy-grey, the crown marked with black lines; two broad lines on each side of the centre of the back and two lateral bars to the tail tuft; underparts buffy-white, darker buff on the breast.

Distribution.—India excepting that portion inhabited by the next bird, *B. œ. astutus*, Burma, Ceylon, S. W. and Central Siam.

Nidification.—Over the greater part of its habitat, our Common Indian Stone Plover breeds principally in April and May but a good many eggs are laid in June and they may be found at odd times from January to August. The birds breed either in bare, open country or, less often, in thin scrub jungle. Another favourite place is a mango tope in which the grass has been allowed to grow fairly thickly amongst the trees. The birds select some small bare patch amongst the grass and deposit their eggs on the ground without any nest or attempt at a lining. When laying in the open country the eggs are occasionally deposited amongst stones, or in ploughed fields and sandy wastes without any cover whatsoever but, as a rule, the birds prefer plains on which there is a little stunted grass or a certain amount of cover, under the shade of which their eggs are placed. Occasionally I have known them to lay amongst fairly thick bushes but this is exceptional. On the other hand, in the north-west of India, mango orchards are undoubtedly the favourite site and Hume mentions finding no fewer than thirteen nests in one such orchard and he adds that there were also present many other birds which had apparently not then laid. Normally, the birds scratch a small hollow in the soil to receive their eggs, but often they are deposited in amongst stones and clods without any attempt at a hollow having been made. Sometimes there may be a little grass or a few stems of weed placed as a lining for the eggs, but more often there is nothing at all. A normal clutch of eggs is two only but Hume several times found three eggs in a clutch and Blewitt also took three eggs together. In shape the eggs are regular ovals, the smaller end but rarely at all compressed, and never peg-top in shape. The ground colour varies from a faint yellowish or greyish white to a deep buff or stone colour. The marking varies considerably. Generally it consists of rather large bold patches and smudges of brown and blackish brown sometimes with a rather strong tinge of red or purple, whilst the secondary markings are of the same character but neutral tint or grey in colour. Occasionally the marks consist in part of patches and in part of irregular streaks and twisted lines, whilst yet more rarely they are all very small and profusely speckled over the whole surface. One such pair of eggs in my own collection, unless closely examined, appears to be a rich buff, and another pair an almost uniform dull grey buff. Sixty eggs average 47·6 by 34·7 mm.; maxima *52·0* mm. by 34·2 mm. and 48·1 by *36·2* mm.; minima *44·0* by 34·0 mm. and 50·3 by *32·0* mm. In Ceylon the Stone-Plover is said to breed from the end of May to October and Parker took eggs in those months, but the only clutch I have seen from that island was taken, fresh, on the 3rd of May.

The incubation seems to be carried on entirely by the female, though the male is occasionally found keeping watch by his mate when sitting and may possibly take his share of incubation during the night. During the middle of the day the eggs are often left unbrooded, unless they are directly in the sun, the heat of which would be sufficient to destroy them.

The Young when first hatched are said to be very helpless and unable to run about at all until they are partially fledged. Indeed Marshall says that they are unable to run until fully fledged. On the other hand some young birds which I found on a sand bank in Assam and which were certainly not half fledged, were able to run well and freely. When they noticed me, it is true they both squatted and lay flat in the sand with their necks outstretched, evidently thinking that they would be more likely to escape detection by hiding than by running away. I picked the little birds up and examined them but when released, they both ran quickly till they reached some stunted grass when they again squatted, compressed as closely as possible in the sand.

Habits.—Our Indian Stone-Plovers frequent almost any kind of dry open country and they may be found as often in ploughed fields and fallow lands as in semi-desert or desert. It is never found in forest and never, I think, among evergreen bushes, but it occasionally resorts to thin deciduous forest such as Sal or scanty scrub. When haunting the banks of rivers or sandbanks, I think it more often selects those which have a little thin cover of grass or equisetum than such as are absolutely bare. Normally it is a plains bird but it occasionally ascends the hills of Southern India, whilst Primrose found it breeding on the banks of the Teesta at about 3,000 feet. Its food consists of insects, worms, snails, frogs, etc., whilst it also swallows many tiny flints and small stones, presumably as an aid to digestion. Occasionally, at all events, it eats grain, as one bird whose stomach I examined had swallowed a large number of grains of millet. This, however, may have been taken together with some small beetles which were infesting the millet at that time. During the heat of the day the Stone-Plover moves about but little and, altogether, they are very crepuscular in their habits, feeding principally in the early mornings and evenings. Their call is a wailing note, sometimes said to be rather like that of the Curlew. It is not at all a bad bird to eat if one can get nothing else but it can hardly be said to have any claim to rank as a sporting bird. In the field it is easily distinguished. When unwatched, it stands about with a rather erect carriage, every now and then making little runs with both head and tail depressed. Its most notable feature undoubtedly is the large size of its head in comparison with the body, whilst, from a short distance, its large eyes attract attention, a fact which has given it the trivial name of the 'Goggle-eyed Plover'. It is a shy bird, difficult to approach or to watch.

BURHINUS ŒDICNEMUS ASTUTUS

The Persian Stone-Plover

Burhinus œdicnemus astutus Hartert, Nov. Zool., 1916, p. 93 (Fao, Persia).

Œdicnemus scolopax.—Blanf. & Oates, iv, p. 294 (part).

Vernacular names.—*Karwanak*, *Barsiri* (Hind.).

Description.—Similar to the preceding bird but much paler, less buff and generally with finer dark striations.

Colours of soft parts as in the other races.

Measurements.—Wing 228 to 244 mm.; culmen 38 to 45 mm.

Distribution.—Merv in Turkestan, Mesopotamia, Persia to Fao and the Persian Gulf, Mekran and Baluchistan, Sind to the Sirsa Desert. Stragglers occur in winter as far as Lahore and I have seen a specimen, apparently of this race, from Oude.

Nidification.—This bird differs in no way in its nidification from the preceding, though it keeps more exclusively to desert country and low stony hills. Occasionally it breeds in thin scrub cover or in thin grass, but the majority of eggs reported have been taken from completely open country. Fifteen eggs average 48·7 by

36·5 mm.; maxima *51·2* by 37·4 mm. and 49·0 by *38·0* mm.; minima *46·6* by 36·5 mm. and 48·0 by *35·5* mm. The eggs are indistinguishable from those of the preceding bird but perhaps average paler on the whole. The breeding months are April, May and June.

Habits.—Similar to those of the other races. Hume found this Stone Curlew frequenting both tamarisk jungle and open hill-sides and refers to their collecting in flocks, on one occasion seeing no fewer than forty of these birds together. Owing probably to the great heat of the sun in Sind and the barren character of the country, it frequents, this race seems to be even more crepuscular than the common Indian form. Ticehurst, Bulkley and Eates all say that during the hot hours of the day one never sees it unless flushed by dogs or beaters, when shooting, for it will lie until almost trampled on.

GENUS ESACUS

Esacus Lesson, Traité d'Orn., p. 547 (1831).

Type, by monotypy, *Esacus recurvirostris* Cuvier.

ESACUS RECURVIROSTRIS

The Great Stone-Plover

Œdicnemus recurvirostris Cuvier, Règne An., i, p. 500 (1829) (no type-locality) (Nepal).

Esacus recurvirostris.—Blanf. & Oates, iv, p. 205.

Vernacular names.—*Barra Karwanak* (Hind.); *Abi* of Falconers; *Gang Titai* (Beng.); *Mien-zin* (Burm.).

Description.—Lores, feathers round the eye and short supercilium white; above the latter a blackish streak and below the eye another through the ear-coverts down the side of the neck; remainder of upper parts pale ashy grey-brown; the crown and nape with very fine shaft-streaks of brown and the shafts elsewhere a little darker than the webs; lateral tail-feathers with broad black tips, white sub-tips, followed by a narrow dark brown line; wing-coverts paler than the back; the innermost lesser coverts and the greater and primary coverts blackish; primaries blackish-brown with a broad white central splash on the first two, smaller on the third and basal on the fourth and fifth; inner primaries white with broad subterminal bands of blackish-brown; outer secondaries brownish-black with white bases and tips paling to the colour of the back on the longest and innermost; a short grey-brown moustachial streak; remainder of lower plumage white.

Colours of soft parts.—Iris yellow or greenish yellow; bill black, greenish yellow or yellow round the base of both mandibles and the posterior nostril; legs and feet yellowish-green, dull pale olive-greenish or pale bluish-green.

Measurements.—Total length about 550 mm.; wing 252 to 273 mm.; tarsus about 80 to 84 mm.; culmen 74 to 87 mm.

Distribution.—India, Burma, Ceylon; Hainan.

Nidification.—The Great Stone-Plover breeds throughout its range from early March to early April and it is probably only when the first clutch has been destroyed that it ever lays later than this. The birds make no nest but lay their eggs in a depression on the bare sand of sandbanks in river beds, more rarely on the shores of the bigger rivers and, not infrequently, on shingle beds. As the eggs have to be hatched and the young able to run about before the rivers come into flood, it is essential that they should be early breeders. There are no authentic records in India of this bird's ever depositing its eggs in ploughed fields or land away from river-beds. In Ceylon, however, Mr. W. E. Wait took eggs on a small island in the Minneri Tank, a large piece of water of some 4,000 acres, in Polan Nasawa in the North-East Province, whilst Oates took eggs in Burma which had been deposited in fallow land on the first of May. The eggs are invariably two only in number and both in shape and colouration are very like those of the Common Stone-Plover but are, of course, considerably bigger. It is, however, noticeable that scrolled rather than blotched eggs are the more numerous with this species. Forty-four eggs average 54·4 by 40·7 mm. ; maxima *57·1* by 43·6 and 55·1 by *43·8* mm. minima *50·1* by 39·0 mm. and 53·2 by *38·1* mm. So far as is known the female only carries on the duties of incubation but the male bird is generally to be seen not far from the nest and may at times relieve her. They do not breed in colonies but two or even three sets of eggs may be found laid in fairly close proximity.

Habits.—The Great Stone-Plover is almost entirely a river bird, though it may occasionally be found feeding on barren or fallow land, not far from the rivers. In their actions they are very much like the Common Stone-Plover. They have the same slow, rather stilted walk and, as soon as discovered, run away with the head and tail depressed just as those birds do. They are generally shy birds, difficult to approach. If disturbed at her nest, the female sneaks off, creeping away as close to the ground as she can and though so large a bird, it is really not very conspicuous. Returning to the nest, she does so with the greatest caution, running towards it a few paces at a time and then stopping to scan the country for any sign of danger. Very often, even when she has got to the eggs, instead of squatting down, she will run forwards a few yards and reconnoitre on the opposite side. Like all this family, they are lethargic birds during the heat of the day, feeding in the mornings and evenings, when they hunt the sand banks for crabs, small molusca, insects, etc. Their principal food undoubtedly consists of the first-named and I have found their stomachs full to repletion of the little, tiny, bright red landcrab so common on the bigger rivers of Eastern India. The Plover has, however, to be very smart to catch these, for his presence on the bank is the signal to every crab to retire to the depths of his burrow, so that the bank which, in the distance, has appeared to be a rosy red from the multitude of red crabs on its surface, changes like a flash to its original dirty mud colour. The bird's call is a loud harsh single note and when frightened or angry they utter a low hiss. Their flesh is quite eatable and at its best tastes rather like Golden Plover but they should only be shot for food when nothing else is obtainable.

Genus Orthoramphus

Orthoramphus Salvadori, Ann. Mus. Civ. Genoa, V, p. 312 (1874).

Type, by monotypy, *Œdicnemus magnirostris* Vieill.

Orthoramphus magnirostris magnirostris

The Australian Stone-Plover

Œdicnemus magnirostris Vieill., Nouv. Dict. D'Hist. Nat., xxiii, p. 231 (1818) (Timor).

Esacus magnirostris.—Blanf & Oates, iv, p. 351.

Vernacular names.—None recorded.

Description.—Whole upper parts light brown, the feathers of the head with dark-brown centres occupying most of the webs and making it look very dark ; feathers of the remaining upper parts dark-shafted and with pale tips ; tail like that of *E. recurvirostris* but central rectrices with broken pale and dark terminal bars ; lesser wing-coverts tipped white, making a wing-bar ; remaining wing-coverts pale grey, the greater with broad white tips, forming a central white bar ; outer primaries brown banded with white, this increasing until the inner primaries are pure white ; secondaries like the back ; feathers round the eye and behind the ear coverts white, all round the white and the lores blackish ; a broad black streak from the lower mandible ; chin and throat white ; lower neck and breast pale grey, with darker shafts, those on the neck broadening to dark streaks ; under tail-coverts buff ; remainder of lower plumage white.

Colours of soft parts.—Iris and orbital skin chrome-yellow ; bill black, yellowish at the extreme base ; legs and feet yellow, greenish-yellow or greyish-yellow ; claws blackish.

Measurements.—Total length 620 mm. ; wing of Andaman birds 266 to 277 mm. ; tarsus 80 to 84 mm. ; culmen 76 to 82 mm.

Distribution.—Andaman Islands, the coasts of the Federated Malay States and islands of the Malay States to Australia.

Nidification.—Within our Indian area this fine Stone-Plover has only been known to breed in the Andamans, where an egg was taken on the 24th of March by Hume and in April by Monsieur Bonig. In the further Eastern Islands it is said to breed from the end of August to early November. Unlike our Great Stone-Plover, which invariably breeds by the larger rivers, this bird is a purely coastal form, laying its eggs on the shingle and sand just above high water mark. It makes no nest, merely scratching a depression either in the shingle itself or in amongst the debris which collects at high water-mark. A single egg only is laid, which in colour and shape resembles those of the Great Stone-Plover but I have one or two eggs which are unlike any others I have seen in this group of birds. In these the ground colour is a very pale stone yellow, almost white, and the markings consist of pale grey patches and smudges, not very large but scattered profusely over the whole of the surface. Fifteen eggs average 63·7 by 45·0 mm. ; maxima *68·5* by 44·3 and 64·3 by *47·1* mm. ; minima *60·2* by *42·8* mm. An abnormally small egg, measures only 54·3 by 41·0 mm.

Habits.—There is very little on record about the habits of this bird, which are apparently very similar to those of other members of the family, except that it is a bird of the sea coasts rather than of the rivers. Its food consists almost entirely of small crustacea and its voice is the loud croak of the family. In its flight also it resembles the other genera and species, that is to say, it is capable of flying at considerable speed but with the expenditure of a great deal of energy in flapping. The legs and head stick out in a line with the body. Like all the *Œdicnemidæ* it is a good swimmer, though it seldom indulges in swimming as a recreation.

(*To be continued*)

REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY

BY

E. BLATTER, S.J., PH.D., F.L.S.

PART X

GRAMINEÆ

BY

E. BLATTER and C. McCANN

(*Continued from page 496 of this Volume*)

TRIBE XII. CHLORIDEÆ

85. OROPETIUM, Trin.; Cke. ii, 1045.

Species 6.—India, Ceylon, Algeria, S. Africa.

1. **Oropetium Thomæum**, Trin. Fund. Agrost. (1820), 98, t. 3; Kunth Enum. Pl. i, 464; Suppl. 375; Miq. Fl. Ind. Bat. iii, 403; Duthie Grass. N. W. Ind. 45, Fodd. Grass. N. Ind. 69; Hook. f. F. B. I. vii, 366; Cke. ii, 1046; Haines Bot. Bihar & Orissa 964.—*Nardus Thomæa*, Linn. f. Suppl. 105; Sm. in Trans. Linn. Soc. i, 116.—*Rottbœllia Thomæa*, Koenig in Naturf. xxiii (1788), 210; Willd. Sp. Pl. i. 464; Roxb. Pl. Corom. ii, 17, t. 133, Fl. Ind. i, 357; Dalz. & Gibs. Bomb. Fl. 300.—*R. pilosa*, Willd. l. c. 465.

Description : Cke. ii, 1045.

Locality : Konkan : Trombay, on rocks (McCann A32!); Antop Hill (McCann 3611!, 2449!).—*Deccan :* Gungapur (Blatter A33!, 584!); Poona (Woodrow); Junnar near Poona (Woodrow).—*S. M. Country :* Dharwar Dist., dry uplands, 2,400 ft., rainfall 34 inches (Sedgwick 2656!); Badami, Fort (Bhide!, Talbot 2923!); Ranibennur (Chibber!).

Distribution : Throughout the plains of India, Ceylon.

86. MICROCHLOA, R. Br.; Cke. ii, 1031.

Species 7. One distributed throughout the tropics, 3 in Afrcia, 3 in Australia.

1. **Microchloa setacea**, R. Br. Prodr. (1810), 298; H. B. and K. Nov. Gen. & Sp. i, 84, t. 22; Beauv. Agrost. 115, t. 20, f. 8; Nees Agrost. Bras. 441; Fl. Afr. Austr. 247; Kunth Enum. Pl. i, 258; Doell in Mart. Fl. Bras. ii, iii, 76, t. 21; Steud. Syn. Gram. 202; Benth. Fl. Hongk. 428; Fl. Austral. vii, 608; Hook. f. in F. B. I. vii, 283; Cke. ii, 1031; Prain Beng. Pl. 1226; Haines Bot. Bihar & Orissa (1924), 964.—*Rotbœllia setacea*, Roxb. Fl. Ind. i (1832), 357, Corom. Pl. ii, 18, t. 132.—*Nardus indica*, Linn. f. Suppl. 105.

Description : Cke. ii, 1031.

Locality : S. M. Country : Dharwar (Woodrow), on dry hill sides, 2,400 ft., rainfall 34 inches (Sedgwick 2908!); Dumbal (Talbot 2949!).—*Kanara :* Halyal (Talbot 2387!).—Usually growing on old walls.

Distribution : Tropics of the Old and New World.

87. CYNODON, Rich; Pers. Syn. Pl. i (1805), 85; Cke. ii, 1032.

Hitchcock (U. S. Dept. Agric. Bull. No. 792 (1920), 178) considers *Panicum dactylon*, Linn. as the type species. He justifies the change of *Cynodon* into *Capriola* in these words : " *Capriola* Adans., Fam. Pl. 2; 31, 532, 1763. The genera are indicated and distinguished by Adanson in a much abbreviated and often unsatisfactory manner. The tabular arrangement of the genera of *Phalarides*, his first section of the grass family or *Gramina*, includes *Capriola* with the following diagnosis, interpreting the table: Summit of leaf sheath hairy; flowers in digitate spikes; glumes laterally compressed, lemna awnless. In the index there is given as a synonym under *Capriola*, '*Gramen dactylon* Offic.' The last phrase appears in the first edition of the Species Plantarum[1] in the synonymy under *Panicum dactylon* as '*Gramen dactylon, radice repente s. officinarum*, Scheuch. gram. 104,' thus connecting *Capriola* Adans. with *Panicum dactylon*.

"*Cynodon* Rich.; Pers. Syn. 1: 85, 1805. Only one species described, *C. dactylon*, based on *Panicum dactylon* L."

In spite of this we have to retain *Cynodon*. Mr. Hubbard of the Kew Herbarium informs us that *Cynodon* is on the list of *nomina conservanda* and according to International Rules must be used, although it is antedated by *Capriola*, Adans. (1763).

Species 3.—India, of which one is cosmopolitan.—Only one in the Bombay Presidency.

1. **Cynodon dactylon**, Pers. Syn. i (1805), 85; Cke. ii, 1032.—*Capriola dactylon*, O. Ktze. pt. ii (1891), 764.—For synonyms see Hook. f. in F. B. I. vii, 288.

Description: Cke. ii, 1032.

Locality: Sind: Sita Road (Sabnis B361!); Jamesabad, fields (Sabnis B907!, B1108!); Sanghar (Sabnis B896!); near Phuleli Canal, cultivated fields (Sabnis B135!); Mirva Canal, sandy banks (Sabnis B265!); Sehwan to Laki, foot of hills (Sabnis B300!); Mirpurkhas, fallow fields (Sabnis B1190!); Gizri, near Karachi (Sabnis B783!); Larkana (Sabnis B458!, B477!); Baghar (Blatter & McCann D690!).—*Gujarat*: Junagad, Kathiawar (Blatter 3785!); Cutch (Blatter 8553!); Dakore (Chibber!).—*Khandesh:* Ankai Hill (Blatter!); Bor, Bori River (Blatter & Hallberg 5482!).—*Konkan:* Very common in Bombay and Salsette Islands (McCann!); Parsik, railway line (McCann A181!); Vihar Lake (McCann 182!).—*Deccan:* Igatpuri (Blatter & Hallberg 5486!, McCann!); Devlali (Blatter & Hallberg 4570!); Khandala, very common (McCann 5433!, 5301!); Purandhar, N. foot and top (McCann 5042!, 5604! bis); Wai (Mamlatdar of Wai!); Panchgani (Blatter & Hallberg B1264!, B1270!, B1329!).—*S. M. Country:* Devarayi forests, 1,800 ft. (Sedgwick & Bell 4102!); Dharwar (Sedgwick!); Haveri (Talbot!).—*Kanara:* (McCann!).

Distribution: Cosmopolitan.

88. GRACILEA, Koen.; Cke. ii, 1030.

Species 2.—India and Africa.

1. **Gracilea Royleana**, Hook. f. in F. B. I. vii (1896), 284; Prain Beng. Pl. 1226; Cke. ii, 1031; Haines Bot. Bihar & Orissa (1924), 965.—*Melanocenchris Royleana*, Nees in Proc. Linn. Soc. i (1841), 95 (*nomen tantum*); Aitchis. Cat. Panjab Pl. 168 (*excl. syn.*); Duthie Grass. N. W. Ind. 33, Fodd. Grass. N. Ind. 54, t. 67; Lisboa in Journ. Bomb. Nat. Hist. Soc. viii (1893), 370.—*M. Jacquemontii*, Jaub. & Sp. Ill. Pl. Or. iv (1850-53), 36, t. 325.—*Pommereulla Royleana*, Steud. Nom. ed. ii, ii, 379.

Description: Cke. ii, 1031.

Locality: Gujarat: Daman (Bhide!); Bhuj Hill, Cutch (Blatter 3764!).—*Khandesh:* Toranmal, rocks (McCann A54!); Amalner, Bori River (Blatter and Hallberg 4451!); Tapti, Bhusawal (Blatter and Hallberg 5453!); To Naradana (Blatter and Hallberg 5212!).—*Konkan:* Bandra (Ryan 1432!); Parsik (Ryan 1215!); Trombay (McCann A52!); Worli Hill, common along sea shore (McCann 5516!); Antop Hill (McCann 3612!).—*Deccan:* Panchgani (Blatter & Hallberg B1278!); Katraj (Bhide!); Sinhagad forest (Bhide!); Near Poona (Jacquemont 383); Poona (Woodrow!); Pashan, near Poona (Gammie!); Chattarshinji Hill, Poona (Ezekiel!); Kirkee (Gammie!); Khandala to Campoli (McCann A57!); Deolali (Blatter A53!, 4545!).—*S. M. Country:* Dharwar Dist., 2,000 ft., rainfall 35 inches (Sedgwick 2278!); Yelvigi, dry hill sides, 1,800 ft., rainfall 28 inches (Sedgwick & Bell 4902!); Dharwar (Talbot 2008!); Belgaum (Stocks, Ritchie 831).—*Kanara:* Yellapore (Talbot!); Karwar (McCann!).

Distribution: Bihar, Rajputana, W. Peninsula, Socotra, Nubia.

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[1] L. Sp. Pl. 58, 1753.

Var. plumosa, Hook. f. in F. B. I. vii (1896), 284; Cke. ii, 1031.—*Melanocenchris plumosa*, Jaub. & Sp. l. c. 37; Hochst. in Flora (1855), 273, 417.—*Pennisetum plumosum*, Hochst. ex Steud. Syn. Gram. 201.—*Ptilonema plumosum*, Steud. l.c.—*Eutriana abyssinica*, R. Br. ex Fresen. in Mus. Senkenb. ii, (1837), 142.

Description : Clusters of spikelets larger, 1·2 cm. long including the awns.

Locality : Jemadar ka Landa near Karachi (Stocks 646).

89. ENTEROPOGON, Nees ; Hook. f. in F.B.I. vii, 284.

Tall, slender, perennial grasses. Leaves long, very narrow. Spikelets very narrow, 1-2-flowered (lower flower perfect, upper if present male or neuter) unilateral in a solitary terminal slender spike, not jointed at the base ; rhachilla jointed at the base. Glumes 3 or 4. Lower involucral glumes unequal, narrow, hyaline, 1-nerved, persistent ; lower floral glume much larger, linear, rigid, scabrid, dorsally rounded, 3-nerved, tip entire, or acutely bifid with a short erect awn in the cleft ; callus bearded. Pale lanceolate, 2-toothed, keels scabrid. Lodicules 2. Anthers very long. Styles distinct. Grain narrow, free within the hardened glumes.

Species 3.—India, Africa.

1. **Enteropogon badamicum,** Bhide in Journ. & Proc. As. Soc, Beng. new series, vii (1911), 517.

Description : Stem 60–75 cm., slender, erect, glabrous. Leaves narrow, 10–18 cm. by 3-6 mm., tapering to a fine acumination, glabrous ; sheath glabrous, finely long-ciliate at the mouth and sides ; ligule a short membrane with a fine fringe of hairs. Spike solitary, terminal, 15 cm. long. Spikelets 2-seriate and secund on a flattened, trigonous, slightly scabrid rhachis, subsessile or very shortly pedicelled. Involucral glumes persistent, empty, scarious, 1-nerved, glabrous or very minutely puberulous, the lower less than half of the upper, more or less unequal-sided and sometimes slightly lobed on one side, ovate, subacute and erose at the apex ; upper shortly unequally 2-dentate at the apex with a short mucro between. Lower floral glume slightly longer than upper involucral, 2-dentate at the apex, 3-nerved with a dorsal stiff awn about as long as the glume, scabrid at the back and sides, ventrally grooved, the groove corresponding with the dorsal ridge which is continuous with the awn. Callus bearded with short white silky hairs. Pale a little longer than the glume, scabrid at the back and on the keels, 2-nerved, apex slightly bifid and erose, with a bisexual flower. Grain oblong, flattened, as long as the pale. Upper floral glume like lower, but smaller and also bisexual ; rhachilla produced beyond the upper floral glume and bearing a sterile awned glume which is much smaller than the upper floral glume.

Locality : S. M. Country : Badami (Bhide ! Talbot 2924 !).

Distribution : So far endemic.

90. CHLORIS, Swartz Prod. Veg. Ind. Occ. (1788), 25 ; (Cke. ii, 1033).

Species about 75.—Tropical and subtropical regions of the Old and New World.

Cooke has 4 species. We add 5 more : *C. pallida*, *C. quinquesetica*, *C. virgata*, *C. montana* and *C. gayana*.

A. Rhachilla not at all produced beyond the lower flowering glume ... ... 1. *C. pallida.*
B. Rhachilla produced beyond the lower flowering glume
  I. Rhachilla produced beyond the flowering glume and bearing 1 awn ... - ... 2. *C. incompleta.*
  II. Rhachilla produced beyond the flowering glume and bearing 1–4 reduced empty glumes
    1. Spikes 1–3. Lower flowering glume broadly cuneiform ... ... 3. *C. tenella.*
    2. Spikes 1–3. Lower flowering glume ovoid, hirsute all over ... ... 4. *C. villosa.*

3. Spikes 2–10. Lower flowering glume bearded at the base and on the margins above the middle
  a. Rhachilla bearing 1–2-awned, tubular or inflated glumes
    * Upper involucral glume awned. 5. *C. virgata.*
    ** Upper involucral glume awnless ... ... 6. *C. barbata.*
  b. Rhachilla bearing 3–4 empty glumes. Spikelets 4-awned altogether ... 7. *C. montana.*
4. Spikes 5–18
  a. Spikes 2·5–5 cm. long ... ... 8. *C. quinquesetica.*
  b. Spikes 6–10 cm. long ... ... 9. *C. gayana.*

1. **Chloris pallida,** Hook. f. in F.B.I., vii, 289; Haines Bot. Bihar & Orissa (1924), 967.—*Schoenfeldia pallida,* Edgew. in Journ. As. Soc. Beng. xxi (1852) 161, 183; Aitchis. Cat. Panjab Pl. 166; Duthie Grass. N. W. Ind. 32, Fodd. Grass. N. Ind. 52, t. 64.—*S. gracilis,* Kunth. Rev. Gram. i, 283, t. 53; Enum. Pl. i, 258; Lisboa in Journ. Bom. Nat. Hist. Soc. vii (1893), 365.

Description: A slender tufted annual, 25–45 cm. high; stems simple or branched, almost filiform. Leaves 10–20 cm. long, linear, very narrow, flaccid, tips capillary, sparsely hairy inside towards the base; ligule of a few hairs. Spikes 1–3, erect, digitate, golden-yellow, 7–13 cm. long, up to 5 mm. broad, closely pectinate with the two rows of erecto-patent long-awned spikelets. Spikelets narrow, tapering, about 2 mm. long without the awns, subsessile. Involucral glumes ovate-lanceolate, subaristately acuminate, 1-nerved, keels ciliate, lower ¼ shorter than the upper. Lower floral glume rather longer than the lower involucral, sessile, ovate, 1-nerved, hairy, base bearded, tip minutely notched, awn 15–25 mm. long, capillary, curved. Pale narrow, keels ciliate, tip 2-dentate. Grain linear, very slender, acute, pericarp loose. Rhachilla not produced beyond the lower floral glume. No rudimentary upper floral glume.

Locality: Gujarat: Sevalia (Chibber!); Lasundra (Chibber!); Kharaghoda, dry salt ground (G.C.H. 537!).—*Deccan:* Lonavla (Gammie!); Charodi (Gammie 16531!).

Distribution: Bundelkhand, Bihar, Central India, W. Peninsula.

2. **Chloris incompleta,** Roth. Nov. Pl. Sp. (1821), 60; Steud. Syn. Gram. 207; Hook. f. in F.B.I. vii, 290; Cke. ii, 1034; Achariyar South Ind. Grass. (1921); 258; Haines Bot. Bihar & Orissa (1924), 968.—*Chloris digitata,* Steud. l. c.; Duthie Grass N. W. Ind. 23; Lisboa in Journ. Bom. Nat. Hist. Soc. vii (1893), 369 (*excl. syn.*).—*C. radiata,* Heyne ex Roth l. c. 61.—*C. Roxburghii,* Edgew, in Journ. As. Soc. Beng. xxi (1853), 160, 183; Duthie Fodd. Grass. N. Ind. 54. t. 65; Lisboa l. c. 368.—*C. tetrameris,* Trin. Gram. Unifl. 235; Steud. l. c. 206.—*Digitaria elongata,* Spreng. Syst. i, 271.—*Gymnopogon digitatus,* Nees in Wight Cat. No. 1753 (ex Hook. f.); Steud. Nom. Ed. ii, i, 713.—*Melica digitata,* Roxb. Fl. Ind. i, 326; Kunth Enum. Pl. t, 37.—*Clenium digitatum,* Spreng. Syst. i, 274.—*Cynodon elongatus,* Trin. in Spreng. N. Entdeck. ii, 64.

Description: Cke. ii, 1034.

Locality: Gujarat: Bulsar, in the shade of trees (Sedgwick 1114!).—*Khandesh:* To Toranmal, in a stony watercourse (McCann 9773! 9774!).—*Konkan:* Thana (Lisboa).—*Deccan:* Nasik (Lisboa).—*S. M. Country.* Deciduous forests W. of Dharwar, 2,000 ft., rainfall 40 inches (Sedgwick & Bell 4499!).—*Kanara:* N. Kanara (Woodrow); Goond (Talbot 2203!); Halyal (Talbot 2382!, 2220!).

Distribution: Throughout the plains of India, Ceylon, China, Afghanistan.

3. **Chloris tenella,** Roxb. Fl. Ind. i (1832), 329; Kunth Enum. Pl. i, 267; Spreng. Neue Entdeck. iii, 126; Steud. Syn. Gram. 204; Dalz. & Gibs. Bomb. Fl. 296; Lisboa in Journ. Bom. Nat. Hist. Soc. vii (1893), 368; Hook. f. in F. B. I. vii, 291; Cke. ii, 1033; Achariyar, South Ind. Grass. (1921), 259.—*C. triangulata.* Hochst. ex A. Rich. Tent. Fl. Abyss. ii, 409; Steud l. c. 203: Duthie Grass. N. W. Ind. 33. *Ctenium indicum,* Spreng

Syst. i, 274.—*Tetrapogon triangularis*, Hochst. Pl. Arab. Schweinf. No. 967 (ex Hook. f.).

Description : Cke. ii, 1033.

Locality : Sind : Jemadar ka Landa near Karachi (Stocks).—*Gujarat :* Surat, on the city walls (Dalzell).—*Khandesh :* W. Khandesh (Blatter !).—*Deccan :* Bijapur (Woodrow).—*S. M. Country :* Badami Fort (Bhide !).

Distribution : Rajputana, W. Peninsula, S. India, Arabia, Abyssinia.

4. **Chloris villosa.** Pers. Syn. i (1805), 87 ; Kunth Enum. Pl. i, 267, Suppl. 217, t. 16, f. 3; Jaub. & Sp. Ill. Pl. Or. iv, 40, t. 327 ; Coss. & Dur. Fl. Alger. 87 ; Aitchis. Cat. Panjab Pl. 167 ; Hook. f. in F. B. I. vii, 291 ; Cke. ii, 1034.—*Chloris tetrapogon*, Beauv. Agrost. (1812), 158.—*Tetrapogon villosus*, Desf. Fl. Atlant. ii, 388, t. 255 ; Trin. Fund. Agrost. 760 ; Boiss. Fl. Or. v, 555 ; Duthie Grass. N.W. Ind. 33, Fodd. Grass. N. Ind. 55, t. 68.

Description : Cke. ii, 1034.

Locality : Sind : Gharo (Blatter & McCann D655 !).—*Gujarat :* Ahmedabad (Sedgwick !).—*S. M. Country :* Sluavar, on dry bunds, 2,000 ft., rainfall 35 inches (Sedgwick 3095 !) ; Yelvigi, 2,000 ft., rainfall 30 inches (Sedgwick 1923 !).

Distribution : Punjab, Rajputana, W. Peninsula, westwards to the Canaries.

5. **Chloris virgata.** Sw. Fl. Ind. Occ. i (1797), 203 ; Trin. Gram. Unifl. 136 ; Doell in Mart. Fl. Bras. ii, iii ; Hook. f. in F. B. I. vii, 291 ; Achariyar South Ind. Grass. (1921), 260 ; Haines Bot. Bihar & Orissa (1924), 968 ;—*Rabdochloa virgata*, Beauv. Agrost. 84.—*Chloris compressa*, DC. Cat. Hort. Monsp. (1813), 94 ; Nees Agrost. Bras. 421, Fl. Afr. Austr. 240 ; Steud. Syn. Gram. 204.—*C. caudata*, Trin. ex Bunge Enum. Pl. Chin. Bor. 70.—*C. cryptostachys*, Steud. in Schmidt Fl. Cap. Virid. 148.—*C. decora*, Nees in Herb. Royle ; Steud. l. c. 205.—*C. elegans*, Kunth Enum. Pl. i, 264.—*C. meccana*, Hochst. & Steud. ex Schult. Ind. Sem. Hort. Hal. (1843) 7 ; Steud. l. c. ; Boiss. Fl. Orient. v, 544 ; Duthie Grass. N. W. Ind. 33.—*C. montana*, Griseb. in Goett. Nachr. (1868), 84, Abhandl. 300 ; Duthie l. c. (*non* Roxb.).—*C. pallida*, Link Hort. Berol. i, 56, ii, 223.—*C. penicillata*, Hort. ex Nees l. c. (*non* Poir.) —*C. polydactyla*, Durand Diss. Chlorid. (1808), 14, 22 ; Jacq. Eclog. Gram. 12, t. 9 (*non* Sw.).—*C. tetrastachys*, Hack. *mss.* (ex Herb. Duthie).—*Heterolepis elegans*, Ehrt. ex Boiss. l. c.

Vern. Names : Kharrut (Sind), Sikaliu, Gadhiu (Surat), Fulkalu (Dohad), Faliu (Broach), Khariu (Charodi), Gonde gavat (Deccan), Ganjali hullu (Karnatik).

Description : A tufted leafy annual grass, 30–60 cm. high. Stems somewhat flattened, erect, leafy at the base, occasionally with creeping stems rooting at the lower nodes. Leaf-blades rather narrow, linear flat, acute, glabrous when old, with scattered long hairs in the leaves of young branches, 5–25 and even 40 cm. long, 3 mm. or less broad. Sheaths glabrous, compressed, upper ones somewhat inflated, margins thin and membranous, mouth of sheath bearded with long hairs in the leaves of young branches, quite glabrous when old and in flower-bearing branches. Ligule a thin, narrow, membranous ridge. Spikes 6–15, erect, crowded at the end of the peduncle, 2·5–6 cm. long, rhachis fine, angular, scaberulous on the edges. Spikelets about 2·5 mm. long excluding the awns, 2-awned, short-stalked, consisting of 4 glumes. Lower involucral glume slender, subulate, glabrous, with the keel glaberulous, 1-nerved, about half the upper ; upper involucral glume oblong-lanceolate, 2-fid at the apex, glabrous except the scaberulous keel, nerve produced between the lobes into a scaberulous awn. Lower floral glume oblong-ovate, cymbiform and rather deep, bifid at the apex and awned in the sinus, margins slightly ciliate up to about the middle and then closely ciliate with long hairs almost to but not to the tip, awn about 6 mm. long, bearded at base, on each side of the dorsal nerve there is a shallow groove with short scattered appressed hairs. Pale much narrower and rather shorter, often reduplicate, toothed or notched. Rhachilla somewhat adnate to lower floral glume, shortly produced, bearing a curious semitubular or bucciniform truncate glume with 2 minute auricles at tip and an awn 8 mm. long. Grain fusiform, sometimes slightly curved, pericarp loose.

Locality : *Gujarat :* Sungiri (Gammie 16585 !) ; Perim Island, Gulf of Cambay (Blatter 3816 ! 3820 !).—*Khandesh :* Bor, Bori River (Blatter &

Hallberg 4425 !) ; Toranmal, S. E. slope (McCann A194 !).—*Konkan :* Lower Parel (Blatter 4279 !), very common in Bombay Isl. (McCann !) ; Parsik, railway line (McCann A195 !).—*Deccan :* Abundant on old walls of houses in Poona (Achariyar) ; Mangiri, near Poona (Gammie 15342 !) ; Katraj Ghat (Gammie 1042 !) ; Gangapur (Blatter & Hallberg 4574 !) ; Igatpuri (Blatter & Hallberg 5118 !, 5145 !) ; Lina Hill, Nasik Dist. (Blatter & Hallberg A190 !) ; Sholapur (D'Almeida A193 !).—*S. M. Country :* Hubli 2,000 ft., rainfall 30 inches (Sedgwick & Bell 4219 !) ; Dharwar, 2,500 ft., rainfall 34 inches (Sedgwick 1818 !).

Distribution : Kashmir (Ladak), Rajputana, Gangetic Plain, Bihar, Burma, W. Peninsula, Central & S. India, westward to Algeria ; Mongolia, tropical and S. Africa and America.

6. **Chloris barbata**, Sw. Fl. Ind. Occ. i (1797), 200 ; Jacq. Eclog. Gram. 10, t. 8 ; Kunth Enum. Pl. i, 264, Suppl. 209 ; Trin. Diss. i, 232, Sp. Gram. Ic. t. 306 ; Nees Agrost. Bras. 421 ; Steud. Syn. Gram. 204 ; Roxb. Fl. Ind. i, 331 ; Grah. Cat. 234 ; Aitchis. Cat. Panjab Pl. 167 ; Duthie Grass. N.W. Ind. 33, Fodd. Grass. N. Ind. 53, t. 34 ; Lisboa in Journ. Bom. Nat. Hist. Soc. vii (1893), 367 ; Griseb. Fl. Brit. W. Ind. 539 ; Benth. Fl. Hongk. 429, Fl. Austral. vii, 613 (*excl. syn. decora*) ; Doell in Mart. Fl. Bras. ii, iii, 67 ; Hook. f. in F.B.I. vii, 292 ; Prain Beng. Pl. 1227 ; Watt. Dict. Econ. Prod. ii, 269 ; Cke ii, 1035 ; Achariyar South Ind. Grass. (1921), 264 ; Haines Bot. Bihar & Orissa (1924), 969.—*Andropogon barbatus*, Linn. Pl. Jam. Pugill. 30, Mantiss. ii, 302. Rheede Hort. Malab. xii, t. 51.

Description : Cke. ii, 1035.

Locality : Sind: Mirpur Sakro (Blatter & McCann D656 !); Tatta (Blatter & McCann D657!).—*Khandesh :* Nim, Tapti bank (Blatter & Hallberg 5399 !) ; to Naradana (Blatter & Hallberg 5163 !, 5182 !); Umalla, Tapti bank (Blatter & Hallberg A188 !).—*Konkan :* Parel, very common in Bombay Island (McCann 5381 !); Sion (McCann 5220 !, 5245 !).—*Deccan :* Chattarshinji Hill, Poona (Ezekiel !); Jeur, Ahmednagar Dist. (Woodrow !).—*S.M. Country : Dharwar* Dist., 2,000 ft., rainfall 35 inches (Sedgwick 1962 !); Haveri (Talbot 2215 !).—*Kanara :* Kulgi (Talbot 2311 !); Yellapore (Talbot 1524 !).

Distribution : Tropics generally.

7. **Chloris montana**, Roxb. Fl. Ind. i, 329 ; Kunth Enum. Pl. i, 265 ; Spreng. Neue Entdeck. iii, 127 ; Steud. Syn. Gram. 204 ; Lisboa in Journ. Bom. Nat. Hist. Soc. vii (1893), 369 ; Hook. f. in F.B.I. vii, 292 ; Achariyar S. Ind. Grass. (1921), 270 ; Haines Bot. Bihar & Orissa (1924), 969.—*C. decora*, Thw. Enum. 371 (*excl. syn.*).—*C. barbata* var. *decora*, Trim. Cat. Ceyl. Pl. 109.

Description : Perennial. Stems erect, tufted geniculately ascending from a creeping base, rooting at the nodes, quite glabrous, 10 cm. to 1–2 m. high. Leaf-blades narrow-linear, finely acuminate, rounded at the base, glabrous, folded flat inwards, 10-20 cm. long, 1·5–3 mm. broad ; sheaths shorter than the internodes, flat, compressed, glabrous, with a few hairs or none at the mouth and with membranous margins, uppermost sheath spathiform, enclosing the inflorescence when young ; ligule a thin ridge of short hairs densely arranged. Nodes glabrous, dark-ringed. Spikes 2-6, very rarely up to 9, 2·5–7·5 cm. long, connate at the base, erect and never spreading. Peduncle slender, long, glabrous, but copiously pubescent just below the base of the connate spikes ; rhachis angular, slender, scabrid. Spikelets about 3 mm. long excluding the awns, short-pedicelled, unilateral, biseriate, thin, slender, 1-flowered, pale or purple tinged, disarticulating above the 2 lower empty glumes which persist on the rhachis, generally 4-, rarely 3- or 5-awned, awns pale or purple, 3–5 mm. long ; pedicel short, angular, scaberulous with a few pilose hairs ; rhachilla produced, but is shorter than the flowering glume. Glumes usually 6, very rarely 5 or 7. Lower involucral glume hyaline, awnless, white or lightly purplish, about 1·5 mm. long, lanceolate, finely acuminate, 1-nerved, and with a scabrid keel ; upper twice as long as the lower, hyaline, oblong-lanceolate, finely acuminate or obtuse and shortly awned, 1-nerved. Lower floral glume broadly oblong, chartaceous, 3- nerved, bearded with long hairs along the margins from a little above the base and with a tuft of hairs at the base, awned at the apex; upper floral glume much smaller, cuneate, conduplicate, awned from the truncate tip, embracing glumes v and vi ; glume v cuneate or subglobose, small, enclosing the still smaller or minute glume vi, both awned. Pale oblong, a little smaller than its glume, folded along the margins. Stamens 3, anthers pale yellow. Styles white with purple stigmas. Lodicules narrowly cuneate.

Locality : Deccan : Nasik (Lisboa).

Distribution : Upper and Lower Gangetic Plain, southward to Ceylon, Coromandel Coast.

8. **Chloris quinquesetica**, Bhide in Journ. & Proc. As. Soc. Beng. (new series) viii (1912), 311.

Description : A glabrous, perennial grass, creeping and rooting at the lower nodes and there forming small tufts of leaves and an erect flowering stem 60 cm. high ; nodes glabrous. Leaves 2–15 cm. long and 3–5 mm. broad, sparsely, delicately long-ciliate when young, ultimately glabrous, lanceolate, acuminate, truncate at the base, margins minutely scabrid ; ligule a narrow fimbriate membrane. Spikes 5–18, 2·5–5 cm. long, crowded in a very short racemose fascicle the branches of which are often decurrent into the peduncle for a short distance and form ridges on it which are also studded with stray spikelets. Peduncle below the spikes and the rhachises hairy. Spikelets 8 mm. long including the awns. Glumes 7 : i and ii empty, iii flowering, awned, paleate, iv-vii barren, epaleate, gradually smaller and rounder, all awned. Lower involucral glume 1·5 mm. long, elliptic-lanceolate, membranous, strongly 1-nerved, slightly oblique : upper 1½ times as long as the lower, elliptic-oblong, membranous, shortly mucronate, strongly 1-nerved. Lower floral glume without the awn as long as the upper involucral, elliptic-obovate, cuneate, coriaceous, 3-nerved, and with a dorsoterminal awn 5 mm. long, lateral nerves densely bearded with long white hairs nearly from the base. Pale as long as the glume but narrower, slightly hairy at the back, very shortly 2-fid at the apex, 2-keeled, keels minutely ciliate. Stamens 3, styles 2, stigmas plumose. Grain plano-convex or trigonous. Lodicules minute.

Locality : Sind : Jamesabad, in fields (Sabnis B1116 !).—*Gujarat :* Bhuj, Bhodir Maka, Cutch (Blatter 3748 !) ; Runn of Cutch (Blatter 3732 !).—*Konkan :* Versova (McCann A185 !) ; Papadi, Bassein, growing on the bunds of rice fields, in semi-salt land (Bhide !) ; Colaba, near a swamp, on rocks, very common (McCann A198 !, A199 !, A200 !).—*Kanara :* Karwar, on red mud near the shore (Hallberg & McCann A197 !).

Distribution : So far endemic.

9. **Chloris gayana**, Kunth. Rev. Gram. i, 89, 293, t. 58, Enum. i, 267, Suppl. 216 ; Nees Fl. Afr. Austr. 240 ; Steud. Syn. Pl. Glum. i, 207 ; Oliv. in Trans. Linn. Soc. 29, 174 ; Durand & Schinz Consp. Fl. Afr. v, 861.—*C. abyssinica*, Hochst. ex A. Rich. Tent. Fl. Abyss. ii, 406 ; Engl. Hochgebirgs Fl. Trop. Afr. 132 ; Schweinf. in Bull. Herb. Boiss. ii, App. ii, 32 ; Durand & Schinz Consp. l. c. 860.—*C. glabrata*, Anderss. in Peters Reise Mossamb. Bot. 557.

Popular Name : Rhodes Grass.

Description : Perennial or annual, 0·6–1·2 m. high ; culms erect or geniculately ascending, or prostrate at the base, simple or branched, often emitting fascicles of barren shoots or short runners from the lower nodes, often robust, 3-9-noded, compressed below, glabrous, smooth, upper internodes usually exserted; sheaths glabrous or sparingly hairy near the mouth, smooth, the lower strongly compressed, keeled, keels sometimes scabrid, the uppermost sometimes tumid ; ligules membranous, very short, long-hairy ; blades linear, long-tapering to a fine point, 15-more than 30 cm. by 6–8 mm. when expanded, flat or folded, glabrous or hirsute near the base, green, smooth below, rough above on the margins. Spikes 6–15, umbelled, sessile, suberect, rarely spreading, 6–10 cm. long, greenish or brownish ; rhachis scabrid ; spikelets 3 mm. long, 3-4-flowered, shortly 2-awned, glumes very unequal, the lower involucral ovate-lanceolate, acute, subhyaline, 1–1·5 mm. long, the upper oblong, obtuse, mucronate, 2–3 mm. long, firmer, scaberulous ; lower floral glume oblong, subobtuse or acute, minutely 2-toothed, ciliolate along the marginal nerves and shortly bearded below the tips or only finely bearded or almost glabrous, with a (sometimes minutely hairy) groove on each face ; awn as long or slightly longer than the glume, straight; callus minutely bearded, pale glabrous, keels scabrid. Anthers 1·5 mm. long; second floral glume with a male flower, like the preceding, but glabrous, 2 mm. long, awn 2 mm. long or less; vth and vith glume rudimentary, cuneate in profile, empty, awnless.

Locality: Deccan: Poona (Burns!).—See also Mann in Bull. 77, p. 72 of Dept. Agric. Bombay.

Distribution: S. and tropical Africa.

91. DACTYLOCTENIUM, Willd Enum. Pl. (1809), 1029.

Annual or perennial; leaves flat, subflaccid; spikes in umbels of 2–6, erect or stellately spreading; tips of the rhachis barren, mucroniform, usually curved. Spikelets 3–5-flowered, laterally compressed, densely imbricate, biseriate, sessile, unilateral on a flattened rhachis, the uppermost reduced; rhachilla tardily disarticulating above the empty glumes, tough between the flowering glumes. Flowers bisexual, the uppermost rudimentary. Involucral glumes 2, unequal, strongly keeled, the lower ovate, acute, thin, persistent, the upper elliptic-oblong in profile, obtuse, mucronate or awned, firm, deciduous. Flowering glumes ovate, subacuminate, 3-nerved, mucronate or awned, deciduous with the grains. Pales about as long as the flowering glumes, 2-keeled, subpersistent. Lodicules 2, cuneate, minute. Stamens 3. Ovary glabrous; styles distinct, very long, subterminally exserted. Grain subglobose, slightly laterally compressed, not grooved or hollowed, rugose or punctate; pericarp very delicate, irregularly breaking away; embryo scarcely equalling ½ the length of the grain; hilum basal, punctiform.

1. Annual; grain subglobose ... ... 1. *D. aegyptium.*
2. Perennial; grain ovoid ... ... 2. *D. sendicum.*

1. **Dactyloctenium aegyptium**, Richt. Pl. Europ. i (1889), 68; Muschler Fl. Egypt i (1912), 108 (*nomen attributum Wildenowio per error.*).—*Cynosurus aegyptius*, Linn. Sp. Pl. 72.—*Dactyloctenium aegyptiacum*, Willd. Enum. Pl. (1809), 1029; Beauv. Agrost. 72, t. 15, f. 2; Kunth Enum. Pl. i, 261, Suppl. ii. 204; Steud. Syn. Gram. 211; Grah. Cat. Bomb. Pl. 235; Dalz. & Gibs. Bomb. Fl. 297; Aitchis. Cat. Panjab. Pl. 167; Miq. Fl. Ind. Bat. iii, 384; Boiss. Fl. Or. v, 556; Griseb. Fl. Brit. W. Ind. 540; Baker Fl. Maurit. 452.—*Eleusine aegyptiaca*, Desf. Fl. Atlant. i (1798), 85; Roxb. Fl. Ind. i, 344; Griff. Notul. iii, 51, Ic. Pl. Asiat. t. 139, f. 79; Benth. Fl. Austral. vii, 615; Duthie Grass. N.W. Ind. 34, Fodd. Grass. N. Ind. 56, t. 35; Hook. f. in F.B.I. vii, 295; Lisboa in Journ. Bom. Nat. Hist. Soc. vii (1893), 374; Prain Beng. Pl. 1229; Cke. iii, 1038; Achariyar S. Ind. Grass. (1921), 276; Haines Bot. Bihar & Orissa (1924), 970.—*E. ciliata*, Rafin. in Desv. Journ. Bot. iv (1814), 273.—*E. cruciata*, Lamk. Illustr. i, 203, t. 48, f. 2.—*E. mucronata*, Stokes Bot. Mat. Med. i, 150; Lisboa in Journ. Bom. Nat. Hist. Soc. vii (1893), 376.—*E. pectinata*, Moench Meth. Suppl. 68.—*E. prostrata*, Spreng. Syst. i, 350.—*E. radulans*, R. Br. Prodr. 186.—*Dactyloctenium distachyum*, Bojer Hort. Maurit. 370.—*D. Figarei*, DeNot. in Ann. Sc. Nat. Ser. iii, ix (1848), 325.—*D. meridionale*, Ham. Prodr. Pl. Ind. Occ. 6.—*D. mucronatum*, Wild. l. c.; Trin. Sp. Gram. Ic. t. 69.—*D. prostratum*, Willd. l. c.—*D. radulans*, Beauv. Agrost. 72; Kunth ll. cc. 262, 204.—*Cynosurus distachyus*, Rottl. ex Steud. Nom. ed. ii, i, 465.—*Chloris mucronata*, Mich. Fl. Am. Bor. i, 59.—*Cenchrus aegyptius*. Beauv. Agrost. 157.—*Rhabdochloa mucronata*, Beauv. l. c.—*Aegilops saccharinus*, Walt. Fl. Carol. i, 249.—Rheede Hort. Mal. xii, t. 69.

Vern. Names: Gandhi (Sind); Anchi, Manchi (Kaira); Tagar sammi (Dharwar); Hakki kalin hullu (Karnatik).

Description: Cke. ii, 1038 (under *Eleusine aeygptiaca*).

Locality: Sind: Ghulamalla, garden (Blatter & McCann D599!); Tatta (Blatter & McCann D600!); Indus Delta (Blatter & McCann D601!); Karachi (Bhide!); Mirpurkhas (Bhide!, Sabnis B1170!); Umerkot (Sabnis B1001!); Hyderabad, cultivated fields (Sabnis B50!); Sukkar, cultivated fields (Sabnis B540!); Nasarpur (Sabnis B1138!, B1059!); Sanghar (Sabnis B888!).—*Gujarat:* Sumarasar, Cutch (Blatter 3759!); Perim Island, Gulf of Cambay (Blatter 3818!); Bhuj Hill, Cutch (Blatter 8551!).—*Khandesh:* Muravad, Tapti bank (Blatter & Hallberg 5164!); Bor, Bori River (Blatter &

Hallberg 5483 !).—*Konkan* : Wada Range, Thana Dist. (Ryan 685 !) ; Juvem (McCann 4264 !); Vetora (Sabnis 33592 !); Mulgaum (McCann A208 !) ; Versova (McCann A205 !) ; Uran (Hallberg & McCann 5135 !) ; Marine Lines, Bombay Isl. (Hallberg A206 !) ; very common in Bombay Isl. (McCann !) ; Ratnagiri (Woodrow 41).—*Deccan :* Poona (Jacquemont 399, 486), Agricultural College garden (Garade 665 !) ; Bopodi, near Poona (Gammie 15310 !) ; Manmad, riverbed (Blatter A211 !) ; Khandala to Campoli (McCann A209 !) ; Khandala (Gammie 15395 !, McCann !) ; Igatpuri (Blatter & Hallberg 5195 !, McCann !) ; Sharanpur, near Nasik (Woodrow).—*S. M. Country :* Yelvigi, 1,800 ft., rainfall 25-30 inches (Sedgwick 2002 !) ; Gokak (Shevade !) ; Badami (Woodrow 12).—*Kanara :* Dundeli, 1,800 ft., rainfall 100 inches (Sedgwick & Bell 4215 !); Halyal (Talbot 2306 !) ; Karwar, sea shore and near sea (Talbot 1298 !).

Distribution : Spread throughout tropical and subtropical regions.

2. **Dactyloctenium scindicum**, Boiss. Diagn. Ser. 2, fasc. 4 (1859), 131, Fl. Or. v (1881) 557.—*Eleusine scindica*, Duthie Fodd. Grass. N. Ind. (1888), 58 ; Lisboa in Journ. Bom. Nat. Hist. Soc. vii (1893), 377.—*Dactyloctenium glaucophyllum*, Courb. in Ann. Sc. Nat. Ser. iv, xviii (1862), 133.—*Eleusine glaucophylla*, Munro ex Benth. in Journ. Linn. Soc. xix (1881), 107.—*E. aristata*, Ehrenb. ex Boiss. Fl. Or. v (1881), 557 ; Hook. f. in F.B.I. vii, 296; Cke. ii, 1039.

Description : Cke. ii, 1039 (under *Eleusine aristata*).

Locality: Sind : Karachi, (Burns !), seeds grown, taken from a bird's crop (Ticehurst !) ; Sanghar (Sabnis B893 !) ; Indus Delta (Blatter & McCann D602 !) ; Mirpur Sakro (Blatter & McCann D603 !); Gharo (Blatter & McCann D604 !); Mundgiro (Stocks 637).—*Gujarat :* Ahmedabad (Woodrow), dry open hills (Sedgwick !); Sevalia (Chibber !);—*Konkan* : Ratnagiri (Woodrow).

Distribution : Punjab, Rajputana, W. Peninsula, Baluchistan, Afghanistan, Arabia, Nubia.

92. ELEUSINE, Gaertn. Fruct. & Sem. i (1788), 7, pl. 1, f. 11 ; Cke. ii, 1037 (*partim*).

Annual or perennial ; leaves long, flat or folded, flaccid or firm ; spikes in interrupted spikes or the upper or all in a terminal umbel, straight, suberect, spreading or deflexed ; spikelets glabrous, 3-6-flowered, laterally compressed, densely imbricate, alternately biseriate, unilateral, sessile on a flattened rhachis, the uppermost terminal, perfect ; rhachilla disarticulating above the involucral glumes and between the flowering glumes, or tough, produced, sometimes terminating with a rudimentary glume. Flowers bisexual. Involucral glumes 2, subequal, persistent, obtuse or obscurely mucronate, membranous, strongly keeled, 3-5 nerved, the lateral nerves close to the keel, the lower shorter, with the keel crested. Flowering glumes very similar, 3-nerved near the base ; lateral nerves submarginal above, with 1-2 short additional nerves close to the keel. Pales slightly shorter than the glumes, 2-keeled, keels winged. Lodicules 2, minute, cuneate. Stamens 3. Ovary glabrous ; styles slender from a broadened base, distinct ; stigmas plumose, laterally exserted. Grain broadly oblong to globose, broadly grooved ; pericarp loose, delicate, breaking up irregularly or almost circumscissile ; seed finely striate ; embryo suborbicular, basal ; hilum punctiform, basal.

Species 6. In the warm regions of the E. hemisphere, 1 widely spread through the tropics.

Of the 5 species mentioned by Cook, 2 have been transferred to *Dactyloctenium* above, viz. *E. aegyptiaca* and *E. aristata*. We add 2 species new to the Presidency : *E. verticillata* and *E. brevifolia*.

A. Erect.
  1. Spikes digitate
    I. Spikes slender, nearly glabrous at base
      Seed oblong, obtusely trigonous ... 1. *E. indica*.
    2. Spikes stout, often incurved pubescent
      at base, seed globose ... ... 2. *E. coracana*.
  II. Spikes scattered or whorled ... ... 3. *E. verticillata*.
B. Prostrate or creeping and rooting
  I. Ligule hairy. Spikes digitate ... ... 4. *E. flagellifera*.
  II. Ligule obsolete. Heads of spikes globose... 5. *E. brevifolia*

1. **Eleusine indica**, Gaertn. Fruct. i (1788), 8; Lamk. Ill. i, 203, t. 48: Kunth Enum. Pl. i, 273, Suppl. 224, t. 16, f. 4; Steud. Syn. Gram. 211; Roxb. Fl. Ind. i, 345; Grah. Cat. Bomb. Pl. 235; Griff. Notul. iii, 52, 53, Ic. Pl. Asiat. t. 119, f. 156 & t. 150, f. 1: Thw. Enum. Pl. Zeylan. 371; Trim. Cat. Ceyl. Pl. 109; Aitchis. Cat. Panjab Pl. 168; Duthie Grass. N. W. Ind. 34, Fodd. Grass. N. Ind. 57, t. 69; Miq. Fl. Ind. Bat. iii, 385; Boiss. Fl. Orient. v, 555; Benth. Fl. Hongk. 429, Fl. Austral. vii, 615; Nees Agrost. Brass. 439, Fl. Afr. Austr. 251; Griseb. Fl. Brit. W. Ind. 540.—*E. distachya*, Trin. ex Steud. Nom. Ed. ii, i, 549.—*E. distans*, Moench. Meth. 210.—*E. domingensis*, Sieb. ex Schult. Mant. ii, 323.—*E. Gouini, inaequalis, rigidifolia, & scabra*, Fourn. ex Hemsl. Biol. Centr. Amer. iii, 565.—*E. gracilis*, Salisb. Prodr. 19.—*E. marginata*, Lindl. in Mitch. Three Exped. i, 319; Steud. Syn. Gram. 212.—*E. tristachya*, Lamk. l.c.; Kunth Revis. Gram. i, 92, Enum. i, 273; Steud. l.c.; Hook. f. in F. B. I. vii, 293; Cke. ii, 1037; Achariyar S. Ind. Grass. (1921), 273, f. 206; Haines Bot. Bihar & Orissa 970.—*Cynosurus indicus*, Linn. Sp. Pl. 72.—*Panicum compressum*, Forsk. Fl. Aeg. Arab. 18.—*Paspalum dissectum*, Kniphof Cent. Bot. in Orig. t. 11.—*Triticum geminatum*, Spreng. Syst. i, 326.—*Agropyrum geminatum*, Schult. Mant. iii, 655.—Rheede Hort. Mal. xii, t. 69.

Description: Cke. ii, 1037.

Locality: Gujarat: Bhuj Hill, Cutch (Blatter 8549 !).—*Khandesh:* Umalla, Tapti bank (Blatter & Hallberg 5231 !); N. slope of Chanseli (McCann A202 !).—*Konkan:* Byculla (McCann A207 !); very common in Bombay and Salsette Isls. (McCann !); Alibag (Ezekiel !); Vetora (Sabnis 33595 !); Bassein (McCann 4478 !).—*Deccan:* Khandala, very common (McCann 9407 !); Khandala to Karjat (Blatter & Hallberg 5323 !); Igatpuri (Blatter & Hallberg 5199 !); Poona (Woodrow).—*S. M. Country:* Dharwar, 2,400 ft., rainfall 34 inches (Sedgwick & Bell 4988 !).—*Kanara:* Yellapore (Talbot 1523 !); Halyal (Talbot 2103 !); Nencholi, near banks (Talbot 954 !).

Distribution: Throughout the plains of India, tropics of the Old World.

* 2. **Eleusine coracana**, Gaertn. Fruct. & Sem. i (1788), 8, t. 1; Lamk. Illustr. t. 28; Schreb. Gram. ii, t. 35; Trin. Sp. Gram. Ic. t. 70; Steud. Syn. Gram. 211; Panz. in Muench. Denkschr. iv (1814) t. 8; Roxb. Fl. Ind. i, 342. Grah. Cat. 235; Dalz. & Gibs. Suppl. 97; Aitchis. Cat. Panjab Pl. 168; Duthie Grass. N. W. Ind. 34; Fodd. Grass. N. Ind. 57, t. 69, Field & Gard. Crops 15, t. 28; Lisboa in Journ. Bom. Nat. Hist. Soc. vii (1893), 373; Hook. f. in F. B. I. vii, 294; Cke. ii, 1039; Prain Beng. Pl. 1229; Haines Bot. Bihar & Orissa (1924), 970.—*Cynosurus coracanus*, Linn. Syst. Ed. ii, 875.—*Eleusine cerealis*, Salisb. Prodr. 19.—*E. sphærosperma*, Stokes Bot. Mat. Med. i, 149.—*E. stricta*, Roxb. l.c. 343.—*E. Tocussa*, Fresen. in Mus. Senkenb. ii (1837), 141.—Rheede Hort. Mal. xii, t. 78.

Vern. Names: Nachni, Nagli, Ragi, Makra, Nanguli.

Description: Very like *Eleusine indica*, but stouter, up to 1·5 m. high. Leaves often far overtopping the stem, 5-6 mm. broad; sheaths compressed, loose; ligule of hairs. Spikes 4–7, suberect, with their ends or whole spike frequently incurved, rhachis of spikes often pubescent at base, somewhat 3-gonous or back flattened. Spikelets much congested, awnless, 3–6-fld. Flowering glumes more broadly ovate than in *E. indica*, and often with 1–2 nerves in the sides, variable in size, up to 5 mm. long. Seed globose, dark brown, smooth in some varieties, in other cases somewhat rugose, with a depressed black hilum and slightly flattened on one side.—A cultivated form of *E. indica*.

Locality: Extensively grown in the hilly districts of the Presidency.

Distribution: Cultivated in the tropics of the Old World for its seed.

Uses: 'It is often said to be a good fodder. This is not my experience, the leaves though soft have very tenacious vascular strands and I have noticed animals frequently reject them after chewing a few times.' (Haines).

3. **Eleusine verticillata**, Roxb. Fl. Ind. i (1832), 346; Steud. Syn. Gram. 211; Aitchis. Cat. Panjab Pl. 168; Duthie Grass. N. W. Ind. 34, Fodd. Grass. N. Ind. 58, t. 70; Lisboa in Journ. Bom. Nat. Hist. Soc. vii (1893), 377; Hook. f. in F. B. I. vii, 295; Saxton & Sedgwick Plants of N. Gujarat in Rec. Bot. Surv. Ind. vi (1918), 322.—*E. racemosa*, Heyne in Roth Nov. Sp. 80.—*Aerachne eleusinoides*, Wight & Arn. in Wight Cat. No. 1760; Nees ex Steud. l.c.—*A. verticillata*, Lindl. Introd. Nat. Syst. ed. ii, 381.

Description : An annual grass. Stems 30–90 cm. high, erect, stout or slender, simple or branched, soft. Leaves flat, rather broad, flaccid, acuminate, glabrous ; sheath compressed ; ligule a few hairs. Spikes few or many, scattered or whorled, or opposite or alternate, suberect, 2–7·5 cm. long, very many-flowered. Spikelets 4–6 mm. long, 8–12 flowered, shining ; glumes small, acute, glabrous. Involucral glumes broadly ovate, finely acuminate or aristulate. Flowering glumes 2 mm. long, very broadly ovate, 3-nerved, keel excurrent, lateral nerves ending in small teeth. Grain rugose, pericarp caducous.
Locality : Gujarat : Ahmedabad, compounds, lanes and banks, common (Saxton and Sedgwick !)
Distribution : Tropics of the Old World.

4. **Eleusine flagellifera,** Nees in Linnæa xvi (1842), 220 ; Steud. Syn. Gram. 211 ; Duthie Grass. N. W. Ind. 34, Fodd. Grass. N. Ind. 57, t. 37 ; Boiss Fl. Or. v, 655 ; Hook. f. in F.B.I. vii, 294 ; Cke. ii, 1038.—*E. arabica,* Hochst. ex Steud. l.c. ; Aitchis. Cat. Panjab Pl. 167 ; Lisboa in Journ. Bom. Nat. Hist. Soc. vii (1893), 377 ; Watt. Dict. Econ. Prod. iii, 241.
Description : Cke. ii., 1038.
Locality : Sind : Jacobabad (Bhide !) ; Mirpurkhas (Jhaveri !) ; Sanghar (Sabnis B889 !, A236 !) ; Umerkot, sand hills (Sabnis B1002 !, B1017 !); Sehwan to Laki, foot of hills (Sabnis B616 !) ; Pad-Idan (Sabnis B511 !) ; Gharo (Blatter & McCann D605 !).—*Khandesh :* (Lisboa).—*Gujarat :* Bhuj Hill, Cutch (Blatter 3746 !). *Deccan :* Poona (Lisboa).
Distribution : Punjab, W. Peninsula, Afghanistan, N. Africa.

5. **Eleusine brevifolia,** R. Br. in Wall. Cat. No. 3815 ; Hook. f. in F.B.I. vii 294 ; Achariyar S. Ind. Grass. (1921), 274.—*Koeleria brevifolia,* Spreng. Pugill. ii, 21.—*K. lagopoides,* Panz. ex Spreng. l. c.—*Dactylis brevifolia,* Koen. ex Willd. Sp. Pl. I, 410 (*excl. syn.*) ; Roxb. Fl. Ind. i, 341.—*D. cynosuroides,* Koen. ex Roth. Nov. Sp. 74 (*non* Linn.).—*Poa brevifolia,* Kunth Rev. Gram. i, 111, Enum. Pl. i, 324.—*Aeluropus brevifolius,* Nees ex Steud. Nom. Ed. ii, i, 30. *A. lævis,* Trin. Fund. Agrost. 143, t. 12.—*A. pubescens,* Steud. Nom. l. c.—*Eragrostris brevifolia,* Benth. in Hook. Ic. Pl. xiv, 51.—*Triodia cynosuroides,* Spreng. Syst. Veg. i, 331.
Description : An annual grass. Stems creeping and spreading from the root, ascending from a decumbent base, generally slender and small, sometimes large and proliferously branched, leafy, 7–18 cm. long. Leaf-blade linear, acute, with a sub-cordate or rounded base, 2–5 cm. long, 3–4 mm. broad ; sheath compressed and glabrous ; ligule a very short membrane, ciliate at the margin or obsolete. Spikes usually many, sessile and crowded in globose heads, varying in diameter from 8–16 mm. Spikelets sessile, biseriate, ovate-oblong, 3–4 mm. long, 4–10-flowered. Involucral glumes membranous, ovate-oblong, acuminate, shortly awned, glabrous, the lower shorter than the upper, 1–3-nerved, the upper 3–5-nerved, and the nerves very close to the middle one in the keel. Lower floral glume and the succeeding ones ovate, cuspidately acuminate, 3-nerved, nerves villous below the middle and paleate. Pale oblong, lanceolate, truncate and minutely 2-toothed, keels villous below the middle. Anthers small. Lodicules small and cuneate. Styles long and slender. Grain orbicular to ovate, concavo-convex, red-brown, and transversely rugose.
Locality : S. M. Country : Ranibennur (Bhide !).
Distribution : Coromandel and Carnatic coasts.

93. DINEBRA, Jacq. Fragm. (1809), 77, t. 121, f. 1 ; Cke. ii, 1039.

Species about 10.—India, Ceylon, Afghanistan, westwards to the Mediterranean and tropical Africa.
Cooke describes one species : *Dinebra arabica,* which name has to cede to *Dinebra retroflexa,* Panzer.

1. **Dinebra retroflexa,** Panzer in Denkschr. Acad. Münch. (1814), 270, t. 12 ; Boiss. Fl. Or. v, 557 ; Muschler Fl. Egypt i (1912), 106.—*Cynosurus retroflexus,* Vahl Symb. ii, 20.—*Dinebra arabica,* Jacq. Fragm. (1809), 77 ; Beauv. Agrost. 98, t. 16, f. 2 (*Dineba*) ; Duthie Grass. N. W. Ind. 34 ; Fodd. Grass. N. Ind. 55 ; Lisboa in Journ. Bom. Nat. Hist. Soc. vii (1893), 372 ; Hook. f. in F. B. I. vii, 297 ; Prain Beng Pl. 1230 ; Watt. Dict. Econ. Prod. iii, 115 ; Cke. ii,

1039; Achariyar S. Ind. Grass. (1921), 279; Haines Bot. Bihar & Orissa (1924), 971.—*Leptochloa arabica*, Kunth Rev. Gram. i, 91; Enum. Pl. i, 271, Suppl. 221; Wight Cat. No. 1756; Aitchis. Cat. Punjab Pl. 167.—*Dinæba aegyptiaca*, Del. Fl. d'Eg. 25, t. xi, f. 3.—*Leptochloa calycina*, Kunth ll. cc. 91, 272; Dalz. & Gibs. Bom. Fl. 297.—*Eleusine calycina*. Roxb. Fl. Ind. i, 346.—*Dactylis paspaloides*, Willd. Enum. Hort. Berol. 111.

Vern. Names : Kali Kauli (Sind); Kharia (Broach); Lona (Poona, Sholapur); Halligyan hullu (Bijapur); Halgyan hullu, Ululgyan hullu, Nari baluda hullu (Karnatik).

Description : Cke. ii, 1039.—A more complete description in Achariyar 279.

Locality : Gujarat : Banks of the Tapti above Surat (Dalzell & Gibson); Surat (Woodrow); Morvi, Kathiawar (Woodrow).—*Khandesh :* Dadgaum (McCann A37 !); Dhulia, Moti Tank (Chibber !); Antab, Bori River (Blatter & Hallberg 5147 !); Bori, Bori River (Blatter & Hallberg 5490 !); Bor, Tapti River (Blatter & Hallberg 5469 !); Tapti River, Bhusawal (Blatter & Hallberg 5157 !).—*Konkan :* Bandra, damp fields at Khar (Vakil A35 !); Sion (McCann 5242 !); Parel (McCann 5104 !); Byculla (McCann A39 !).—*Deccan :* Deolali (Blatter A34 !); Sholapur (D'Almeida B36 !); along the river, Dhond (Bhide 1346 !); Bairawadi, Purandhar (McCann 5050 !); Poona (Woodrow), Agricultural College Farm (Ezekiel !).—*S. M. Country :* Dharwar Dist. (Sedgwick 2101 !); Kelgerry (Talbot 2623 !); Haveri (Talbot 2184 !).—*Kanara :* Yellapore (Talbot !).

Distribution : India, Ceylon, Afghanistan, westward to Egypt and Senegal.

94. TRIPOGON, Roth Nov. Sp. (1821), 79; Cke. ii, 1035.

Species about 13.—Tropical and subtropical Asia and Africa, one in America.

To the 4 species given by Cooke we add 3 others: *T. bromoides*, Roth, *T. filiformis*, Nees, and *T. Roxburghianum*, Bhide.

Key :

A. Flowering glumes simply bifid with an interposed awn, the lobes awned or not
  I. Awn as long or longer than its glume
    1. Under 8 cm. high. Leaves 2·5 cm. long. Ligule membranous, ovate ... 1. *T. pauperculus.*
    2. 15–45 cm. high. Cauline leaves 15–20 cm. long. Ligule a ridge ... ... 2. *T. capillatus.*
  II. Awn shorter than its glume
    1. Lateral lobes of floral glume not awned
      a. Leaves 30–60 cm. long. Spikelets 5–12-flowered. Lower involucral glume 2 mm. long, lanceolate ... 3. *T. Lisboæ.*
      b. Leaves 5–20 cm. long. Spikelets 10–20-flowered. Lower involucral glume 3 mm. long with a projecting lobe at one side ... 4. *T. Jacquemontii.*
    2. Lateral lobes of floral glume mucronate 5. *T. Roxburghianum.*
B. Flowering glumes 4-fid, outer lobes awned or not, inner membranous, sometimes very short or truncate
  I. Upper involucral glume deeply notched or bifid at the apex ... ... 6. *T. bromoides.*
  II. Upper involucral glume minutely 2-toothed below the tip ... ... 7. *T. filiformis.*

1. **Tripogon pauperculus**, Stapf in Hook. Ic. Pl. (1896) t. 2442 (*pauperulus per err.*); Hook. f. in F.B.I. vii, 285; Cke. ii, 1036.

Description : Cke. l. c.

Locality : Konkan : Matheran (Woodrow !).—*Deccan :* Mahableshwar, rocky summit of Sindola plateau (Sedgwick & Bell 4845 !); Panchgani (McCann !); on the crest of the Western Ghats (1890 ft.) 8 miles south of Lonavla on *Ficus glomerata*, in company with mosses and *Utricularia orbiculata* (Woodrow 25);

Khandala, common on rocks (McCann A65!, A66!); near Karli on rocks (Woodrow!).—*S. M. Country :* Dud-sagar (Talbot 2568); Castle Rock, on rocks (Bhide!); Poondra (Talbot 4306!).—*Kanara :* On rocks on a hill near Nagangari 2,600 ft., rainfall 100 inches (Sedgwick 2895!).—This grass usually grows on rocks together with mosses and other small plants during the rainy season.

Distribution : Endemic in the W. Peninsula.

2. **Tripogon capillatus**, Jaub. & Spach Illustr. Pl. Or. iv (1850-53), 47, t. 332; Hook. f. in F.B.I. vii, 285; Cke. ii, 1036; Haines Bot. Bihar & Orissa (1924), 966.—*T. capitatus* (*per error.*) Lisboa in Journ. Bom. Nat. Hist. Soc. vii (1893), 371.

Description : Cke. l. c.

Locality : Khandesh : Toranmal, edge of plateau, 3,000 ft. (McCann A61!).—*Konkan :* On trees, Matheran (Woodrow!, Lisboa).—*Deccan :* Panchgani (Blatter & Hallberg B1247!, B1288!); on trees about Poona (Jacquemont 580); Khandala, common on trees and rocks (McCann A61!, Garade!).—*S. M. Country :* Castle Rock, 1,800 ft., rainfall 300 inches (Sedgwick & Bell 4332!); Belgaum, on trees on Samboti Hill (Ritchie 866); Anmod, on trees (Talbot 2621!).—*Kanara :* Sumpkhund to Sirsi, on trees (McCann!).

Distribution : Bihar, W. Peninsula, Mt. Abu.

3. **Tripogon Lisboae**, Stapf in Kew Bull. (1892), 84; Hook. f. in F.B.I. vii, 286; Cke. ii, 1036.—*Tripogon* sp. nov. Lisboa in Journ. Bom. Nat. Hist. Soc. vii (1893), 370.

Description : Cke. l. c.

Locality : Konkan : Parsik Hill (McCann A337!).—*Deccan :* Purandhar (McCann 5009!); Khandala, common, on rocks (McCann A334!, Bhide!); Karli, between Poona and Lonavla (Jacquemont 581); Panchgani, on Tableland (Blatter A338!). Generally forming large tufts and growing on rocks overhanging water-courses.

Distribution : Mt. Abu, W. Peninsula.

4. **Tripogon Jacquemontii**, Stapf in Kew Bull. (1892), 85; Lisboa in Journ. Bom. Nat. Hist. Soc. vii (1893), 370; Hook. f. in F.B.I. vii, 286; Cke. ii, 1037; Haines Bot. Bihar & Orissa (1924), 966.

Description : Cke. l. c.

Locality : Gujarat : Lasundra (Chibber!).—*Khandesh :* N. slope of Chanseli (McCann A335!).—*Konkan :* Bombay district, without precise locality (Lisboa); Matheran (Woodrow).—*Deccan :* Devlali (Blatter & Hallberg 4468!); Sholapur (Pinwill); near Ahmednagar (Miss Shatuck); Gangapur (Blatter & Hallberg A339!): Khandala (Blatter & McCann 3599!); Poona (Jacquemont 353, Woodrow); Agricultural College compound, Kirkee (Bhide!); Purandhar (McCann 5573!); Mahableshwar, W. side of plateau (Sedgwick!).—*S. M. Country :* Belgaum (Talbot!); Dharwar (Talbot 2301!); dry hill sides near Dharwar (Sedgwick 2896!).

Distribution : Bengal, Bihar, Central India, W. Peninsula.

5. **Tripogon roxburghianum**, Bhide in Journ. & Proc. As. Soc. Beng. (new series) vii (1911), 515.—*Lepturus Roxburghianus*, Hook. f. in F.B.I. vii, 365 (*fortassis* Steudel).

Description : 10–18 cm. high. Stems tufted. Leaves filiform, scarcely longer than 2·5 cm., ciliate with long hairs on the margin and at the ligule; sheaths glabrous, margins hyaline; ligule an oblong lacerated membrane. Spike solitary, 5-6 cm. long. Spikelets 3 mm. long, 1–2-flowered, with the rhachilla jointed and produced beyond the upper flower and borne on a flattened rhachis, the internodes of which are alternately concave and convex. Lower involucral glume hyaline, very oblique or slightly lobed on one side, broadly 1-nerved, remaining attached to the hollow in the rhachis when the spikelet is removed. Upper involucral glume very coriaceous and thick, broadly 3-nerved, about 2½ times as long as the lower. Lower flowering glume a little shorter than the upper involucral, dorsally hairy in the lower part, membranous, 3-nerved, 2-toothed with a short mucro between, teeth also shortly mucronate. Callus bearded. Pale nearly as long as the glume, 2-keeled, keels minutely scabrid. Stamens 3. Styles 2, distinct, stigmas plumose. Grain terete. Lodicules 2, cuneate. Upper flower also bisexual or imperfect or 0. When complete it is like the lower.

Locality : Deccan : Chattarshinji Hill, Poona (Bhide!, Ezekiel!).—*S.M. Country :* Badami Fort (Bhide!); Dharwar, dry barren uplands, 2,400 ft. (Sedgwick!).

Distribution : So far endemic.

6. **Tripogon bromoides,** Roth Nov. Sp. (1821), 79; Steud. Syn. Gram. 301; Stapf in Kew Bull. (1891), 85; Hook. f. in F.B.I. vii, 287.—*T. festucoides,* Jaub. & Spach Ill. Pl. Or. iv, 49, t. 333.—*T. lanatus,* Hochst. ex Steud. l.c.—*Plagiolytrum calycinum,* Nees in Proc. Linn. Soc. i, 95.—*Avena mysorensis,* Spreng. Syst. i, 337.

Description : Stems 15–45 cm. high, stout or slender. Leaves usually short, but sometimes as long as the stem, flat or convolute, and filiform. Spike long or short, 7–20 cm. long. Spikelets very variable, 4–12 mm. long, few- or many-flowered, close or distant. Lower involucral glume ovate or lanceolate, deeply notched on one side, membranous, nerve stout; upper oblong-lanceolate, deeply bifid, with a short awn in the cleft, membranous or coriaceous, with broad membranous margins. Lower floral glume and following bearded at the base, broadly ovate, strongly 3-nerved, 4-fid, outer lobes small, placed low down and margined with their awns half as long as the glume or longer, inner lobes often half as long as the glume, much larger than in any other species, awn rarely as long as its glume.

Locality : Deccan : Poona, Agricultural College Farm (Chirka!); Katraj Ghat (Gammine!); Mahableshwar, 4,500 ft., rainfall 270 inches (Sedwick & Bell 4567!), summit of Sindola plateau (Sedgwick & Bell 4841!).—*S.M. Country :* Belgaum Fort, walls, 2,600 ft., rainfall 50 inches (Sedgwick 2950); from Belgaum southwards (*teste* Hook. f.); Dharwar (Talbot 2301!); Bijapur Dist. (Talbot 2929!); Badami (Bhide!).

Distribution : W. Peninsula, Ceylon.

7. **Tripogon filiformis,** Nees ex Steud. Syn. Gram. 301; Duthie Grass. N. W. Ind. 33; Hook. f. in F.B.I. vii, 288; Collett Fl. Simlensis (1902), 619, fig. 196. —*T. semitruncatus,* Nees *et T. unidentatus,* Nees ex Steud. l.c.; Duthie l.c.—*Plagiolytrum filiforme et unidentatum,* Nees in Proc. Linn. Soc. I, 95.—*Catapodium filiforme,* Nees ex Duthie l.c.

Description : Stem 10–40 cm. high, very slender. Leaves filiform, as long as the stem. Spikes 4–25 cm. long. Spikelets crowded, 4–10-flowered, 3–8 mm. long. Lower involucral glume ovate, broadly lobed on one side; upper narrowly lanceolate, sharply toothed on one or both margins near the tip. Flowering glumes 2-toothed at the tip, teeth actute or jagged, a long awn inserted in the cleft and a shorter awn on the outer side of each tooth, the glume thus being 3-awned, middle awn twice as long as the glume or longer.

Locality : Deccan : Wai (Talbot 4485!).—*S.M. Country :* Belgaum (Talbot!).

Distribution : Temperate Himalaya, Khasia Hills, W. Peninsula.

TRIBE XIII. PAPPOPHOREÆ

95. ENNEAPOGON, Desv.; Cke. ii, 1040.

Species about 6, in the dry warm regions of the Old World and in Australia; 1 species in Western N. America.

There is only one species in the Bombay Presidency.

1. **Enneapogon elegans,** T. Cooke in Cooke Fl. Bomb. Pres. ii, 1040.—*Pappophorum elegans,* Nees in Wight Cat. No. 1771 (1833); Hook. f. in F. B. I. vii, 301; Steud. Syn. Gram. 199; Duthie Grass. N. W. Ind. 35.—*Calotheca elegans,* Wight & Arn. ex Steud. l.c.

Description : Cke. ii, 1040.

Locality : Sind : Laki (Bhide!); Karachi District (Woodrow).

Distribution : Peshawar, W. Pennisula, Burma.

TRIBE XIV. ORYZEÆ

96. ORYZA, Linn. (Cke. ii, 1042).

The spikelet of *Oryza* has been variously interpreted. Hook. f. has the following description *:* ' Glumes 2–3, i and ii much the smallest, empty, scale or bristle-like, rarely 0 ; iii chartaceous, obtuse, actute or awned, strongly 3–5–nerved ; palea as long as the glume.'

Cooke speaks of 5 glumes, ' the 2 lower involucral glumes below the articulation of the spikelet minute, scale-like (rarely absent) ; the 2 next involucral glumes, above the articulation of the spikelet subulate ; floral glume solitary, dimidiate-oblong, coriaceous or chartaceous, 5–9–nerved, awnless or with a short or long straight terminal awn ; palea linear or lanceolate, as long as the glume, 3-5-nerved.'

Stapf thinks that the usual 2 outer empty involucral glumes are absent, that the next 2 (scales or bristles) are empty florets (valves). He also takes the ivth-glume to be a pale.

Species about 17.—Tropical.—2 species in the Bombay Presidency.

1. Ligule very short, scarcely longer than broad,
fringed with short hairs ... ... 1. *O. coarctata.*
2. The lower ligules very long, up to 4 cm.,
always much longer than broad ... 2. *O. sativa.*

1. **Oryza coarctata**, Roxb. Hort. Beng. (1814), 87, Fl. Ind. (1832), 206 ; Griff. Notul. iii, 8, Ic. Pl. Asiat. t. 142, f. 1 ; Miq. Fl. Ind. Bat. iii, 371 ; Hook. f. in F. B. I. vii, 93 ; Prain Beng. Pl. 1184 ; Cke. ii, 1042 ; Prodoehl *Oryzeæ* in Bot. Arch. i (1922), 232.—*O. triticoides*, Griff. Notul. l.c. – *Sclerophyllum coarctatum*, Griff. l.c.

Description : Cke. ii, 1042.

Locality : Sind : Karachi, in Herb. Kew without collector's name ; covering large flats at the mouth of the Indus River (Blatter & McCann !) ; Shikarpur (Dr. King's collector) ; Keti (Blatter & McCann D666 !) ; after Keti (Blatter & McCann D665 !).—*Kanara :* Sulgeri (Sedgwick & Bell 4241 !).—Forming dense mats and covering miles of flat land at the mouth of the Indus river within tidal influence, being covered at high tide.

Distribution : Sundribuns, W. Peninsula.

2. **Oryza sativa**, Linn. Sp. Pl. (1753), 333 ; Gaertn. Fruct. ii, 5, t. 80, f. 5 ; Host. Gram. Austr. iv, t. 325 ; Lamk. Encycl. t. 264 ; Kunth Enum. Pl. i, 7, Suppl. 4 ; T. Nees Gen. Fl. Germ. Monocot. i, 2 ; Roxb. Fl. Ind. ii, 200 ; Griff. Ic. Pl. Asiat. t. 139, f. 149 ; Duthie Grass. N. W. Ind. 12, Field and Gard. Crops 15, t. 4, Fodd. Grass. N. Ind. 20 ; Miq. Fl. Ind. Bat. iii, 368 ; Doell in Mart. Fl. Brass. ii, ii, 7, t. 1 ; Benth. Fl. Austral. vii, 550 ; Hook. f. in F. B. I. vii, 92 ; Cke. ii, 1043.—*O. communissima*, Lour. Fl. Cochin (1790), 267.—*O. glutinosa*, Lour. l.c. 267.—*O. montana*, Lour. l.c. 267.—*O. montana*, Ham. in Wall. Cat. (1828), 8633.—*O. praecox*, Lour. l.c. 267.—*O. perennis*, Mnch. Meth. (1794), 197.—*O. palustris*, Hamilt. Prodr. (1796), 25.—*O. latifolia*, P. Beauv. Agrost. (1812), 27 (*non* Desv.).—*O. parviflora*, P. Beauv. l.c.—*O. denudata*, Desv. ex Steud. Nomencl. ed. i (1821), 577.—*O. elongata*, Desv. ex Steud. l.c.—*O. marginata*, Desv. ex Steud. l.c.—*O. mutica*, Lour. ex Steud. l.c.—*O. pubescens*, Desv. ex Steud. l.c.—*O. rubribarbis*, Desv. ex Steud. l.c.—*O. emarginata*, Steud. Nomencl. ed. ii (1841), 234.—*O. pumila*, Host. ex Steud l.c. 234.—*O. rufipogon*, Griff. Not. iii (1851), 5.—*O. glumæpatula*, Hochst. ex Steud. Syn. Pl. Glum. i (1854), 3.—*O. nepalensis*, Don ex Steud. l.c. 3.—*O. repens*, Herb. Ham. ex Steud. l.c.—*O. segetalis*, Russ ex Steud. l.c.—*O. sorghoides*, Desv. ex Steud. l.c.—*O. caudata*, Trin. ex Doell in Mart. Fl. Bras. ii, 2 (1871), 8.

Description : Annual. Stems creeping or floating, 60 cm. to 3 m. high. Leaves 30–60 cm. by 6–8 mm. or more, striate, scaberulous, 1-nerved ; sheaths smooth ; ligule long 2-partite. Spikelets loosely panicled, not imbricating, awn 7–13 cm. long, yellow or reddish, shining. Involucral glumes $\frac{1}{4}$–$\frac{1}{3}$ the length of the floral glume, lanceolate ; floral glume hispid above, dorsally spinescently ciliate, awn very long.

This is Hook. f.'s description prepared from the plant which Roxburgh and other Indian writers consider to be the indigenous Rice.

For a note on the inflorescence see : S. G. Bhalerao : The Morphology of the Rice Plant and of the Rice Inflorescence. In Journ. of Ind. Bot. Soc. v (1926), 13.

Much interesting information on *Oryza sativa* can be had in

Watt, G. : Dictionary of Economic Products of India v (1891).
Watt, G. : Commercial Products of India (1908).
Heuzé : Les Pl. Aliment. des Pays Chauds (1899), 14-116.
Mollison : Textb. Ind. Agric. iii (1901), 32–44.
Semler : Trop. Agrik. iii (1903), 1–48.
Copeland, E. B. : Rice (1924).
Statistical Atlas of the Bombay Presidency, 1925.

Wild Rice : We possess little reliable information regarding the Wild Rices of the Presidency. S. G. Bhalerao (in Agric. Coll. Mag. xx (1928), 45) has published a paper on 'The Wild Rice (*Oryza sativa*) of the Bombay Presidency', which contains a number of interesting observations.

According to him the wild type of Rice 'occurs abundantly on the Western Ghats and occupies the zone where the rainfall is over 30–35 inches. As an annual aquatic, it occurs in marshy areas, in small pools and ponds and on the margins of the big tanks. It is rarely found in more than 3 feet depth of water and on land without any standing water as well.'

We have found a Wild Rice in pools on Tableland at Panchgani (rainfall 60 in.).

97. HOMALOCENCHRUS, Mieg. Act. Helv. Phys. Math. 4 (1760), 307. (*Leersea*, Sw.)

Description : Cke. ii, 1041 (*Leersea*).

We follow O. Kuntze (Rev. Gen.) and Hitchcock (Genera of Grass. Unit. St. in U.S. Dept. of Agric. Bull. 772 (1920), 205) in going back to the genus *Homalocenchrus*. Hitchcock says that one species is referred to the genus with certainty, another being doubtfully referred to it. No specific names are used, but under the first there are two citations which appear in the Species Plantarum under *Phalaris oryzoides*, Linn. which Hitchcock considers as type species.

Species 14.—Tropical and temperate regions.

Only one species in the Presidency.

1. **Homalocenchrus hexandrus**, O. Kuntze Rev. Gen. (1891), 777.—*Leersia hexandra*, Sw. Prodr. Veg. Ind. Occ. (1797), 131 ; Fl. Dan. t. 1744 ; Kunth Enum. Pl. i, 6 ; Host. Gram. Austr. t. 35 ; Engl. Bot. t. 2908 ; Reichb. Ic. Fl. Germ. i, t. 52 ; Duthie Grass. N.W. Ind. 12 ; Miq. Fl. Ind. Bat. iii. 367 ; Benth. Fl. Austral. vii, 549 ; Hook. f. in F.B.I. vii, 94 ; Cke. ii, 1042 ; Haines Bot. Bihar & Orissa (1924), 981.—*Asprella hexander*, Roem. & Schult. Syst. ii (1817), 267.—*Leersia australis*, R. Br. Prodr. (1810), 210 ; Kunth l. c. 6.—*Asprella australis*, Roem. & Schult. l. c.—*Oryza australis*, A. Br. ex Schweinf. Beitr. Fl. Aethiop. (1867), 300 ; Aschers.—Schweinf. Ill. Fl. d'Eg. 167, No. 1148.—*Leersia ciliata*, Roxb. Hort. Beng. (1814), 26 ; Aitchis. Cat. Panjab Pl. 157 ; Duthie l. c., Fodd. Grass. N. Ind. 21.—*L. ciliaris*, Griff. Not. iii, 2.—*L. glaberrima*, Trin. Oryz. 7 ; Miquel l. c. 368.—*L. mexicana*, H. B. & K. Nov. Gen. & Sp. i (1815), 195 ; Kunth l. c. 6 and ii, 2, Suppl. 2, Rev. Gram. 178, t. 1.—*Asprella mexicana*, Roem. & Schult. l. c.—*Oryza mexicana*, Doell. in Mart. Fl. Bras. ii, ii (1871), 10.—*Zizania ciliata*, Spreng. Syst. ii (1825), 136 ; Kunth Rev. Gram. i. 8 ; Griff. Not. iii, 1.—*Oryza hexandra*, Doell in Mart. Fl. Bras. ii, ii (1871), 10.—*Pharus ciliatus*, Retz. Obs. v (1779), 23.—*Pseudoryza ciliata*, Griff. Ic. Pl. Asiat. t. 144, f. 1.—*Turraya nepalensis*, Wall. Cat. 8637D.—*Blepharochloa ciliata*, Endl. Gen. 1352.—*Hygroryza ciliata*, Nees ex Steud. Nomencl. ed. ii, i (1841), 783.—*Leersia brasiliensis*, Spreng. Nov. Prov. (1819), 47.—*Asprella brasiliensis*, Roem. & Schult. Mant. ii (1824), 153.—*Leersia contracta*, Nees Agrost. Bras. (1829), 516.—*L. luzoniensis*, Presl. Rel. Haenk. i (1830), 207.—*L. parviflora*, Desv. Opusc. (1831), 61.—*L. abyssinica*, Hochst. ex A. Rich. Tent. Fl. Abyss. ii (1851), 356.—*Asprella purpurea*, Bory Hort. Maurit. (1837), 376.—*Leersia elongata*, Willd. herb., No. 1511 ex Trin. in Mem. Acad. Petersb. 6 ser. iii (1839), 172.—*L. mauritanica*, Salzm. ex Trin. l. c. 174.—*L. Triniana*, Sieb. ex Trin. l. c. 174.—*L. gracilis*, Willd. herb. No. 1512 ex Trin. l. c. 173.—*L. Griffithiana*, C. Mill. in Bot. Zeitg. xiv

(1856), 345.—*L. capensis*, C. Mill. l.c. 345.—*L. Gouini*, Fourn. ex Hemsl. Biol. Centr.—Am. Bot. iii (1885), 514 (*nomen*).—*Homalocenchrus Gouini*, O. Kuntze Rev. Gen. (1891), 777.—*Leersia ægyptiaca*, Fig. & De Not. in Mem. Ac. Torin. ser. ii, xiv, (1853), 317.— *L. ferox*, Fig. & De Not. l. c. 319.

Description : Cke. ii, 1042, under *Leersia hexandra*.

Locality : S. M. Country : Devaraji (Sedgwick & Bell 4463 !) ; Sadambi Tank, Tadas (Sedgwick 2052 !) ; Sluavar, in tanks (Sedgwick 2289 !) ; Castle Rock, in rice field (Bhide !) ; Kunnur, margin of tank (Sedgwick 4930 !) ; Londa (Woodrow).—*Kanara :* (McCann !) ; Halyal Tank (Talbot 1345 !, 2147 !).

Distribution : More or less throughout India, Ceylon, Africa, America, Australia.

98. HYGRORYZA, Nees in Edinb. N. Phil. Journ. xv (1833), 380 ; Cke. ii, 1041.

Species 1.—India, Ceylon, Tonkin.

1. **Hygroryza aristata**, Nees in Edinb. N. Phil. Journ. xv (1833), 380 ; Duthie Grass. N. W. Ind. 12, Fodd. Grass. N. Ind. 20 ; Aitchis. Cat. Pan. Pl. 157 ; Hook. f. in F.B.I. vii, 95 ; Trin. Fl. Ceyl. v, 185 ; Prain Beng. Pl. 1185.—*Pharus aristatus*, Retz. Obs. v (1779–91), 23.—*Leersia aristata*, Roxb. Hort. Beng. (1814), 26, Fl. Ind. ii (1832), 207 ; Griff. Not. iii, 3.—*Zizania aristata*, Kunth. Rev. Gram. i (1830), 8 ; Enum. Pl. i, 10.—*Z. Retzii*, Spreng Syst. ii (1825), 136.—*Potamochloa Retzii*, Griff. Journ. As. Soc. Beng. v, (1836), 571, t. 24, f. 2, Not. iii, 8, Ic. Pl. Asiat. t. 139, f. 147 & t. 140.—*Pharus natans*, Herb. Russell ex Wall. Cat. (1828) No. 8638 ; Rheede Hort. Mal. x, t. 12.

Description : Cke. ii, 1041.

Locality : Gujarat : Chikli (Woodrow).—*Konkan :* Bhiwandi, near Kalyan (Chibber !) ; Nagotna (Gammie 16063 !) ; Kurnul, pond (Ezekiel !) ; bank of Vihar Lake (McCann !).—*Deccan :* Poona, Agricultural College Garden (Bhide !, McCann !).

Distribution : Of genus.

TRIBE XV. FESTUCEÆ

99. ELYTROPHORUS, Beauv. ; Cke. ii, 1044.

Species 1.—Tropical Asia, Africa and Australia.

1. **Elythrophorus articulatus**, Beauv. Agrost. (1812), 67 ; Cke. ii, 1044.—For synonyms see Hook. f. in F.B.I. vii, 1044.

Description : Cke. l. c.

Locality : Gujarat : Godra (Woodrow).—*Konkan :* Alibag, rice field near water works (Ezekiel !) ; Penn (McCann 5504 !, 5509 !) ; Condita (McCann 4242 !) ; Bhandup, in damp rice field (Nana A46 !) ; Kalyan (Woodrow).—*Deccan :* Khandala, Bushy Lake, in dry bed (McCann 9392 !) ; Matheran (Gammie 1664 !) ; Karjat, Honad Taluka (Bhonsle !) ; Igatpuri (Blatter & Hallberg 5144 !, 5494 !).—*S. M. Country :* Chabbi, rice field, 2,000 ft., rainfall 30 inches (Sedgwick 3705 !) ; Londa (Woodrow).—*Kanara :* Halyal (Talbot 1370 !).

Distribution : Of the genus.

100. AELUROPUS, Trin ; Cke. ii, 1045.

Species few.—From the Mediterranean and Caspian regions to the Punjab, Sind, and S. India.—Only 1 species in the Bombay Presidency.

1. **Aeluropus villosus**, Trin. ex L. Mey. Verz. Pflanz. Cauc. (1831), 18 ; Cke. ii, 1045. For synonyms see Hook. f. in F.B.I. vii, 334.

Description : Cke. l. c.

Locality : Sind : Near salt creeks in Sind (Stocks 506) ; Gharo (Blatter & McCann D659 !, D660 !) ; Mirpur Sakro (Blatter & McCann D658 !) ; Karachi (Bhide !, Woodrow) ; Laki (Bhide !) ; Kotri, banks of Indus (Sabnis B370 !) ; Sehwan, clayey plains (Sabnis B606 !) ; Sehwan to Laki, foot of hills (Sabnis B108 !) ; Sanghar (Sabnis B891 !).—*Gujarat :* Surat, mud-flats, mouth of

Tapti River (Hallberg A29 !) ; Porbandar (Bhide !) ; Dharasna (Chibber !) ; road to Gola (Chibber !) ; Karie Roa, Cutch (Blatter 3770 !, 3773 !) ; Kala, Pachan Isl., Cutch (Blatter 3739 !) ; (Runn of Cutch Blatter 3730 !, 3731 !).—*Konkan :* On the salt ground near the sea (Graham, Lisboa) ; Bandra, salt marsh (Vakil A28 !) ; Penn (McCann A31 !) ; Bassein Creek (Chibber !) ; Nagaon, Sion, salt marsh (McCann 5240 !) ; Salsette (Wight 53).

Distribution : Punjab, Sind, W. Peninsula, in salt ground, Ceylon, Afghanistan, Persia, Caspian region, Arabia, Mediterranean region.

101. CENTOTHECA, Desv. ; Cke. ii, 1043.

Species doubtfully 3.—Tropical Africa, Asia, Australia.—One species in the Presidency.

1. **Centotheca lappacea**, Desv. in Nouv. Bull. Soc. Philom. ii (1810), 189, *et in* Journ. Bot. i (1813), 71 ; Cke. ii, 1043.—For synonyms refer to Hook. f. in F.B.I. vii, 332.

Description : Cke. l. c.

Locality : Konkan : Vetora (Sabnis 33564 !, 33727 !).—*Kanara :* Castle Rock, evergreen forests, 1,600 ft., rainfall 250 inches (Sedgwick 2714 ! ; Gammie 15693 !) ; Guddhalli, Karwar (Hallberg & McCann A25 !) ; Katgal (Hallberg & McCann A26 !) ; Devimani Ghat (Hallberg & McCann A27 !) ; on a fern stem (Woodrow !).

Distribution : Himalayas, Khasia Hills, Central India, Burma, W. Peninsula, Ceylon, Malaya, China, Polynesia, tropical Africa.

TRIBE XVI. HORDEÆ

102. LEPTURUS, Br. ; Hook. f. in F.B.I. vii, 365.

Small, slender grasses. Leaves flat or convolute. Spikelets 1–2-flowered, sessile, solitary, half-immersed in hollows of the rhachis of a simple, terminal, articulate or not-straight or incurved spike with the back of the lowest floral glume opposite the rhachis ; rhachilla jointed. Glumes 3 or 4. Lower involucral glume minute or 0, upper longer than the flowering glumes, linear, rigid, acute, 5-nerved, erect or at length deflexed ; flowering glumes much shorter than the upper involucral glume, hyaline ; pale 2-keeled. Lodicules 2, cuneate, or lobed. Stamens 1–3. Ovary glabrous ; styles short, distant. Grain narrow or oblong, glabrous, free.

Species 6.—The Old World.—One species in the Presidency, new to it.

1. **Lepturus repens**, R. Br. Prodr. (1810), 207 ; Brongn. in Duperr. Voy. Bot. 57, t. 16 ; Kunth Enum. Pl. i, 463, Suppl. 374 ; Steud. Syn. Gram. 357 ; Benth. Fl. Austral. vii, 663 ; Hook. f. in F.B.I. vii, 365.—*Rotboellia repens*, Forst. Prodr. 9.—*Monerma repens*, Beauv. Agrost. 117.—*Lepturus aciculatus*, Steud. Syn. Gram. 357.—*Lolium Coelorachis*, Forst. in Herb. Paris, Steud. Nom. ed. ii, ii, 64.

Description : A perennial grass. Stem elongate, woody, branched and widely creeping below. Leaves 7 to 15 cm. long, 3-6 mm. broad, spreading or erect, acuminate, glaucous ; sheaths glabrous or mouth ciliate ; ligule inconspicuous. Spikes shortly peduncled, fragile. Spikelets 2-fid ; rhachilla elongate, bearing an upper imperfect flower. Involucral glumes 1 (or 2 in the uppermost spikelet) flat, rigid, 6–12 mm. long, closely appressed to the rhachis ; flowering glume, much shorter than the involucral, elliptic, concave, 3-nerved. Pale 2-keeled. Lodicules fleshy, obliquely truncate or 2-lobed, glabrous. Grain oblong.

Locality: Kanara : 4 miles from Halyal (Bhide).

Distribution : N. Kanara, Ceylon, Malay and Pacific Islands, Australia.

103. TRITICUM, LINN.

* 1. **Triticum sativum,** Lam. Fl. Fr. ed. 1, iii (1778), 625.

We are not in a position to discuss the many varieties or forms that are cultivated in the Presidency. We refer to some literature which may help those who wish to make further inquiries into this very complicated question.

Hackel in Engler & Prantl. Pflanzenfam. ii, 80.

Murray in Watt Dictionary of Economic Prod. vi, pt. 4, 89.

Koerneck & Werner, Handbuch der Getreide Arten.

Howard, A. and Howard, G.L.C. The varietal characters of Indian wheats. Mem. Dept. Agr. Ind. (Bot. ser.) ii (1908), and many other papers on wheat which were mostly published by the Department of Agriculture in India.

Schulz, A. Die Abstammung des Weizens. Mitt. natf. Ges. Halle a. S. I. (1912), 14–17.

Percival, J. The wheat plant: a monograph. 463 p., 218 f. London 1921.

Huber, J. A. Ueber Abstammung und Systematik des Weizens. in Naturforscher iii, (1927), 577–582.

Cooke mentions 2 varieties which are chiefly grown in the Presidency:

(*a*) Var. *spelta*. This is Linné's *Triticum Spelta*.

(*b*) Var. *pilosa*. This is *Triticum pilosum*, Dalz. & Gibs.

104. HORDEUM, LINN.

1. **Hordeum vulgare**, Linn. Sp. Pl. (1753), 84.

The following three varieties are grown in the Bombay Presidency.

(*a*) Var. *hexastichon* = *Hordeum hexastichon*, Linn. Sp. Pl. (1753), 85.

(*b*) Var. *distichon* = *H. distichon*, Linn. l.c.

(*c*) Var. *nudum* = *H. nudum*, Arduini ex Schult. Mant. ii. (1824), 437. We refer to:

Schulz, A. Die Abstammung der Saatgerste, *Hordeum sativum*. Mitt. Natf. Ges. Halle a. S.I. (1912), 18–27.

Wiggans, R. G. A classification of the cultivated varieties of Barley. Cornell Agr. Exp. Stat. Mem. 46 (1921), 365–456.

Blaringhem, L. Sur les caractères d'espèces élémentaires d'Orges (*Hordeum*). Bull. Soc. Bot. France 71 (1924), 623–27.

TRIBE XVII. BAMBUSEÆ

105. BAMBUSA, Schreb. Gener. Plant. (1789) no. 607. (Cke. ii, 1046).

Species 73.—Eastern Asia, Australia.—One species indigenous in the Presidency, and 2 commonly cultivated.

I. Stem and branches unarmed
  1. Spikelet subcylindric; fertile flowers 5–9 .. 1. *B. nana*.
  2. Spikelet compressed, flattened, distichous, fertile flowers 5–6 ... ... 2. *B. vulgaris*.
II. Stem and branches armed ... ... 3. *B. arundinacea*.

* 1. **Bambusa nana**, Roxb. Hort. Beng. (1814), 25, Fl. Ind. ii, 190; Munro Monogr. Bamb. in Transact. Linn. Soc. xxv (1866), 89; Gamble Ind. Bamb. Ann. Roy. Bot. Gard. vii (1896), 40, t. 38; Brandis Ind. Trees 669; Camus, Bambusées (1913), 121, pl. 37, f. B.—*B. glaucescens*, Siebold Cat. ex Munro.—*B. glauca*, Lodd. Cat.—*B. caesia*, Sieb & Zucc. ex Munro.—*B. sterilis*, Kurz in Miquel Ann. Mus. Bot. Lugd. Bat. ii, 285.—*B. viridi-glaucescens*, Carrière in Revue Hortic. (1869), 292 (*non* Riv.).—*B. aurea*, Franchet & Savatier (*non* A. & C. Rivière).—*Ischurochloa floribunda*, Büse in Miq. Pl. Jungh 390; Miquel Fl. Ind. Bat. iii, 422.—*Arundinaria glaucescens*, P. Beauv. Agrost. 144; Ruprecht in Act. Acad. Caes. Petrop. (1840), 23, t. 1, fig. 3; Munro Monogr. l.c. 22.—*Panicum arborescens*, Linn.—*Triglossun arundinaceum*, Fisch. *apud* Roem. & Schult. Syst. 846.—*Ludolfia glaucescens*, Willd. in Mag. Gesell. N. F. Berlin (1808), 320.

Description: Stems densely tufted, 2–3 m. high, rarely more, 3 cm. in diam., glabrous, green when young, then yellow, unarmed, hollow, much branched from the base; branches fascicled, semiverticillate, often dichotomous. Sheaths of young shoots glabrous, striate, very long, attenuate, apiculate, lanceolate, truncate at the apex, surmounted by an imperfect limb rather long-acuminate and decurrent into 2 ciliate auricles. Leaves often small, 2·5–7·5 cm. long, the larger ones often attaining 14 cm. by 5–7 mm., rounded at the base, long-acuminate, smooth or pubescent below, scabrous on the margins, glaucous-bluish; secondary nerves 5–7 pairs, not tessellate, but provided with pellucid glands. Spikelets 12–45 mm. long, few clustered or solitary on the branches of short diffuse panicles, straw-coloured, shining, 5–9-flowered ; sometimes with bractiform subfoliaceous scales at their bases ; rhachilla glabrous, flattened. Glumes all flowering or rarely the lowest empty, ovate, acute, many-nerved. Pale shorter than the glumes, keels minutely ciliate at or near the tip only. Stamens long-exserted, pendulous ; anthers obtuse or finely apiculate, yellow. Ovary obovoid, pubescent at the apex. Style very short, divided from almost the base into 3 long and hairy stigmas. Grain elliptic, furrowed, shortly beaked, top hairy.

Distribution : China, Japan.—Cultivated in Manila, Luzon, Java, Malay Peninsula, India, Europe.

* 2. **Bambusa vulgaris,** Schrad. *apud* Wendl. Collect. Pl. ii (1810), 26, t. xlvii; Rupr. in Act. Acad. Caes. Petrop. (1840), 137, t. xi, fig. 47 ; Munro, Monogr. 107 ; Bedd. Fl. Sylv. ccxxxii ; Brandis Ind. Trees 670 ; A. & C. Rivière Les Bambous 191 ; Gamble Ind. Bamb. 43, pl. 40 and in Hook. f. F. B. I. vii, 391. Camus Les Bambusées (1913), 122, pl. 76, f. fA.—*B. Thouarsii*, Kunth Not. Gen. Bambus. in Journ. Phys. (1822), 148 ; Rupr. Bambus. 48, t. xi, f. 48.—*B. surinamensis*, Rupr. in Act. Acad. Caes. Petrop. (1840), 49, t. xi, 49.—*B. Sieberi*, Griseb. Fl. Brit. W. Ind. 528.—*B. humilis*, Reichb. ex Rupr.—*B. arundinacea*, Moon Cat. 26 ; Ait. Hort. Kew. ed. ii, 316.—*B. auriculata*, Kurz. *apud* Houz. de Lehaie.

Description : Stems unarmed, 6–15 m., 5–10 cm. in diam., first green, then yellow, or striped, polished ; nodes hardly raised, with usually a ring of brown hairs ; internodes 25–45 cm. long, walls rather thin. Stem-sheaths 15–25 cm. by 17–23 cm., often streaked with yellow, thickly hairy above, top rounded, retuse ; blade 5–15 cm., appressed hairy on both surfaces, base rounded, decurrent with rounded, falcate, fimbriate auricles ; ligule broad, toothed or fimbriate. Leaves linear-lanceolate, 15–25 cm. by 16–40 cm., pale, petioled, glabrous, tessellate by pellucid glands, tip twisted, scabrid, nerves 6–8 ; sheath laxly hairy ; ligule short, ciliate, auricle rounded. Panicle large, leafy. Spikelets 15–20 mm., in bracteate clusters of 3–10 oblong, acute, bifid, empty glumes, 1–2 ovate, many-nerved with the tip ciliate ; flowering glumes 6–10, larger. Pale as long as the glume, keels white, ciliate. Lodicules 3, winged, ciliate. Anthers obtuse, hairy, apiculate, purple. Ovary narrow, hairy ; style long.

Distribution : Mauritius, Bourbon, Madagascar, Hawaii, Java.—Cultivated in other countries.

A handsome variety is grown in Indian gardens :

Var. striata, Auct. mult.—*Bambusa striata*, Lodd. ex Lindl. in Penny Cyclop. iii (1835), 357 ; Munro Monograph 121 ; Curtis Bot. Mag. xxx (1874) t. 6079.—Var. *vittata*, A. & C. Rivière l. c.—*B. vulgaris vel culmis variegatis*, Hort. Gall.—*B. variegata*, Hort.—Var. *aureo-variegata*, Hort.

Rather smaller in size. The stems are striped with yellow and green, the stripes alternating at every node ; the branchlets are yellow and the leaves somewhat smaller and paler. On drying the stripes disappear.

Distribution : Probably the result of cultivation in China and Japan.

3. **Bambusa arundinaria,** Retz. Obs. v (1789), 24 *sub* Bambos ; Willd. Sp. Pl. ii (1799), 245 ; Roxb. Corom. Pl. i, 56, t. 79, Fl. Ind. ii, 191 ; Poir. Encycl. viii, 701 ; Rupr. in Act. Acad. Caes. Petrop. (1840), 51, t. xiii, fig. 50 ; Munro, Monogr. 103 ; Brandis Ind. Trees 671 ; Bedd. Fl. Sylv. ccxxi ; Gamble Ind. Bamb. 52 *et in* Hook. f. F. B. I. vii, 395 ; Duthie Fodd. Grass. N. Ind. 70 ; Cke. ii, 1046 ; Camus Les Bambusées (1913), 128, pl. 75, f. A.—*B. Arundo*, Klein ex Nees in Linnæa ix (1834), 471 ; Rupr. Bamb. l. c. 53, t. 13, f. 53.—*B. Neesiana*, Arn. ex Munro l. c.—*B. orientalis*, Nees l. c. 475 ; Rupr. l. c. 52, t. 13, f. 51.—*H. pungens*, Blanco Fl. Filip. ed. i, 270.—*B. spinosa*, Roxb. Fl. Ind. ii, 198.—*Arundo Bambos*, Linn. Sp. Pl. 81.—*A. indica arborea*, Auct.—*Nastus arundinaceus*, Sm. in Rees Cycl. xxiv, no. 1.

Description : Cke. ii, 1046.

Locality : Gujarat : (Gamble) ; Dangs (Woodrow).—*Konkan :* Kanary Caves (McCann A215 !, A216 !) ; Wada Range (Ryan 494 !) ; Vetora (Sabnis 33282 !) ; Western Ghats (Gamble).—*Deccan :* Igatpuri (McCann A218 !) ; Karli (Gammie 16169 !) ; Khandala, St. Xavier's Villa (McCann A224 !, A225 !).—*Kanara :* Karwar (Hallberg & McCann A217 !) ; 3 miles from Mirjan (Hallberg & McCann A 220 !).

Distribution : India, Burma, Ceylon.—Often cultivated.

106. OXYTENANTHERA, Munro ; Cke. ii, 1047.

Species 16.—Malay Peninsula, Siam, India, tropical Africa.—2 in the Bombay Presidency.

1. Spikelets 1-flowered ; style glabrous ... 1. O. *Ritcheyi*.
2. Spikelets 2-flowered ; style hairy ... ... 2. O. *Stocksii*.

1. **Oxytenanthera Ritcheyi**, *nov. comb.—Bambusa Ritcheyi*, Munro in Trans. Linn. Soc. 26 (1868), 113.—*Oxytenanthera monostigma*, Bedd. For. Man. in Fl. Sylv. (1873) ccxxxiii, *et* Ic. Pl. Ind. Or. (1874), 56, t. 234 ; Gamble Ind. Bambus (1896), 74, t. 65 ; Brandis Ind. Trees (1911), 674 ; Talbot For. Fl. Bombay ii (1911), 571; Camus Bambusées (1913), 148 ; Troup Silvic. Ind. Trees iii (1921), 1006.—*Schizostachyum hindostanicum*, Kurz in Proc. As. Soc. Beng. 52, ii (1873), 252.

Why we made the change from O. *monostigma* to O. *Ritcheyi* is evident from the synonymy.

Description : Cke. ii, 1048.

Locality : Konkan : Ghats (Talbot, Woodrow).—*Deccan :* Sakhar-Pathar Hill near Lonavla (Woodrow) ; Satara Ghats (Brandis) ; Mahableshwar (Fagan) ; Poona District (Wroughton) ; Ahmednagar (Wilkins).—*S. M. Country :* (Ritchie 820).—*Kanara :* N. Kanara (Woodrow) ; Wuddermone (Talbot 905 !, 252 !) ; Arbail Ghat (Talbot 906 !) ; Arbail (Talbot 251 !, 857 !) ; Godhuli (Talbot 583 !) ; Supa (Talbot !).

Distribution : W. Peninsula.

2. **Oxytenanthera Stocksii**, Munro in Trans. Linn. Soc. xxvi (1868), 130, Bedd. For. Man. in Fl. Sylv. (1873), ccxxxiii ; Gamble Bamb. Brit. Ind. 75, t. 66, *et* in Hook. f. F.B.I. vii, 403 ; Cke. ii, 1048 ; Talbot For. Fl. Bombay ii, 570 ; Camus Les Bambusées (1913), 149.

Description : Cke. ii, 1048.

Locality : Konkan : (Stocks).—*Deccan* : Panchgani, planted (Woodrow).—*Kanara :* Kumpta, cultivated (Talbot 269 !, 3601 !) ; Karwar (Talbot 856 !) ; commonly cultivated along the coast ; rare in the Ghat forests of N. Kanara (Talbot).

Distribution : W. Peninsula, Indo-China.

107. DENDROCALAMUS, Nees ; Cke. ii, 1049.

Species 24.—Africa, Indo-Malaya, Philippines, China.

1. Stem-sheaths 7–30 cm. long ; leaves up to 25 by 3 cm. ... ... 1. *D. strictus*.
2. Stem-sheaths 50 cm. long, as broad at the base ; leaves up to 50 by 10 cm. ... ... 2. *D. giganteus*.

1. **Dendrocalamus strictus**, Nees in Linnæa 9 (1834), 476 ; Miq. Fl. Ind. Bat. ii, 421 ; Munro Monogr. 147 ; Bedd. Fl. Sylv. t. cccxxv ; Brandis Ind. Trees 675 ; Duthie Fodd. Grass. N. Ind. 71 ; Gamble Bamb. Brit. Ind. 78, t. 68, 69 *et in* Hook. f. F.B.I. vii, 404 ; Cke. ii, 1049 ; Camus Les Bambusées (1913), 152 pl. 87, f. B.—For synonyms see F.B.I. vii, 404.

Description : Cke. ii, 1049.

Locality : Sind : Junnar Hill (Burns !).—*Gujarat :* Junagad, Datar Hill, Kathiawar (Chibber !) ; Panch Mahals (Woodrow).—*Khandesh :* To Toronmal (McCann 9791 !) ; base of Toranmal (McCann A221 !).—*Konkan :* Planted (Woodrow).—*Deccan :* Rocky hills (Gamble) ; Karli (Gammie 16167 !) ; Ganeshkhind Botanic Gardens (Patwardhan !).—*S. M. Country :* Byadgi, Dharwar Dist. (Talbot !).—*Kanara :* Karwar (Talbot !) ; Ambgaum (Talbot 1788 !) ; Dongi Nallah (Talbot 959 !).

Distribution : India, Java.

*2. **Dendrocalamus giganteus**, Munro in Trans. Linn. Soc. xxvi (1868), 150 ; Kurz Ind. Forester i, 346 ; Gamble Bamb. Brit. Ind. 88, t. 76 *et. in.* Hook. f. F.B.I. vii, 406 ; Brandis Ind. Trees 678 ; Cke. ii, 1050 ; Camus Les Bambusées (1913), 159, pl. 85, f. A.—*Bambusa gigantea*, Wall. Cat. Bot. Gard. Calc. 79 ; Gardeners' Chronicle pl. Sept. 1892.

Description : Stems 20-30 m. by 20-25 cm. in diam., branched above; nodes hairy, internodes rather short, grey-green, young with waxy scurf; walls thin. Stem-sheaths 50 cm. long, as broad at the base, deciduous, thinly strigose with golden hairs, top depressed; blade 12-40 by 9 cm., decurrent into glabrous, stiff, brown wavy auricles, narrowed above into a short point; ligule 5-12 cm., stiff, black, margin serrate. Leaves up to 50 by 10 cm., oblong, cuspidately acuminate, tips twisted, young hairy beneath, midrib strong, nerves 12-16 pairs, with pellucid cross bars. Panicle very large, branchlets slender, curved; heads up to 2·5 cm. diam., 1·2-2·5 cm. apart. Spikelets 12 mm. long, ovoid, acute, spinescent, puberulous, sometimes all flowering; rhachilia produced with an imperfect glume. Involucral glume ovate, mucronate, striate; flowering glumes 3-6, thin, mucronate, many-nerved. Anthers acuminate. Ovary ovoid and long style hairy; stigma simple. Grain oblong, obtuse, hairy above.

Distribution : India (Tenasserim, Malay Peninsula, Penang, Malacca, Perak), Cochin-China. Cultivated in gardens of India, Ceylon and Europe.

108. TEINOSTACHYUM, Munro.

Stems thin, overhanging, sometimes climbing. Stem-sheaths usually thin. Leaves various. Panicle spiciform, on leafy branches. Spikelets up to 7·6 cm. long, slender, many-flowered, sometimes pedunculate, in bracteate whorls, upper and lower flowers imperfect. Involucral glumes 1-2, mucronate; flowering glumes similar, mucros longer. Pale convolute, keels ciliate. Lodicules 3, 3-9-nerved. Stamens 6, filaments free, slender. Anthers obtuse or obtusely apiculate. Ovary ovoid or depressed-globose, apex produced enclosing the style; stigmas 2-3, plumose. Grain ovoid, acuminate, beaked, pericarp crustaceous.

Species 5.—India, Ceylon.—One species in the Bombay Presidency; not mentioned by Cooke.

1. **Teinostachyum Wightii**, Bedd. Fl. Sylv. t. cccxxiii, Forest Man. ccxxxiii (*excl. syn.*); Gamble Bamb. Brit. Ind. 99, t. 87, *et in* Hook. f. F.B.I. vii, 410; Brandis Ind. Trees 679; Camus Les Bambusées (1913), 163.

Description : Stem 3-6 m. by 2·5-3 cm., semi-scandent; branches pendulous; nodes narrowly ringed; internodes bright green, rough above; walls thin. Stem-sheaths 25-30 by 2·5-3 cm., papery, hirsute with black-brown hairs, top truncate, not auricled; blade subulate, 12-17 cm., decurrent on the sheath; ligule 2·5 mm. Leaves 15-40 cm. by 2·5-5 cm., oblong-lanceolate, acuminate, tip scabrous, twisted, whitish and sparsely hairy beneath, midrib broad, yellowish, nerves 6-7 pair, tessellate by glands; sheath glabrous; ligule narrow. Panicle large, with spiciform drooping branchlets; rhachis smooth, slender; rhachilla of spikelets slender, flattened and concave below, thickened and ciliate above. Spikelets 12-25 mm. Involucral glume 1, ovate, mucronate, 5-7-nerved, dorsally hirsute; flowering glumes 1 or 2, mucronate, nerved transversely. Lodicules ovate, short-ciliate, 3-5-nerved. Ovary stalked, depressed-globose, smooth, style included in the long beak of the ovary. Grain stoutly stalked, ovoid, beaked, glabrous.

Locality : Ghats of N. Kanara.

Distribution : Nilgiris, Anamalais, about 3,300-5,000 ft. altitude.

109. OCHLANDRA, Thw.; Cke. ii, 1050.

Species 11.—India, Ceylon, Malay Peninsula, Java, Madagascar.—Only one species in the Bombay Presidency.

I. **Ochlandra Talboti.** Brandis Ind. Trees (1911), 684; Talbot For. Fl. Bombay ii (1911), 572; Cke. ii, 1050; Camus Les Bambusées (1913), 181.—*O. stridula*, Woodr. Journ. Bom. Nat. Hist. Soc. xiii (1901), 442 (*non* Thw.).

Ochlandra Rheedii var. Sivagiriana, Gamble which Talbot (l. c.) identifies with *Ochlandra Talboti*, has been described as a distinct species by Camus under the name : *Ochlandra Sivagiriana* in Les Bambusées (1913), 181.

Description : Cke. ii, 1050.

Locality : Kanara : Gersoppa Falls (Talbot 3628 !, McCann !) ; Katgal (Talbot 3506 !, McCann !) ; Yellapore (Bell !) ; near Sulgeri (Bell 3357 !) ; Dadmune (Talbot !) ; common throughout the Kanara forests (McCann !) ; Honavar, at Alanki (McCann !).

Distribution : Endemic in N. Kanara.

A Correction.

In vol. 32 (1927), 27 we made a new combination *Hemarthria glabra.* Mr. Hubbard of Kew informs us that this combination is invalid and gives the following explanation :

' R. Brown described the genus *Hemarthria* in his Prodr. Fl. Nov. Holl. 207 (1812). He had two species *H. compressa* and *H. uncinata*. The first, *H. compressa,* is accompanied by a descriptive phrase of three words, then the letter J. denoting one of his specimens from Port Jackson or that neighbourhood (in Australia), followed by *Rottboellia compressa,* Linn. f. Suppl. 114 ; thus *Hemarthria compressa* was really based on *Rottboellia compressa,* Linn. f. The Australian plant which R. Brown cited, was incorrectly identified by him with *R. compressa,* Linn. f. ; that together with all the Australian material is referable to his *Hemarthria uncinata*. *Rottboellia compressa,* Linn. f. was based on a plant collected in India ; our Indian specimens all agree with this specimen and are all *Hemarthria compressa,* (Linn. f.) R. Br. We have no Indian material of *Hemarthria fasciculata,* (Lam.) Kunth and those specimens identified by Hooker in Flora of British India and by others as *Rottboellia compressa var. fasciculata,* (Lam.) Hack., are all typical *Hemarthria compressa. H. fasciculata,* Kunth is based on *Rottboellia fasciculata,* Lam., a species originally described from North Africa and now known to occur throughout Africa, in the Mediterranean region and in America.'

Our *Hemarthria glabra,* therefore, must be called *Hemarthria compressa,* (Linn. f.) R. Br.

The species is known from Afghanistan, India, China and Indo-China.

The other species, *Hemarthria fasciculata,* Kunth (xxxii (1927), 28 of this series) for which we had no locality, but which we included on the authority of others, must be excluded, as it has not been observed in India.

(*To be continued.*)

THE STUDY OF INDIAN BIRDS

BY

HUGH WHISTLER, F.Z.S., F.L.S.

PART III

(*With plates* C, D, E *and* F.)

(*Continued from page 325 of this volume*)

SOME EXTERNAL CHARACTERISTICS OF BIRDS

The Beak

After the feathers of a bird I think we are accustomed to think of its beak[1] as one of its most characteristic features. In the beak, at any rate, there are far more important and conspicuous variations than in the wings, tail or feet, and they are closely correlated with the most important question in a bird's life, its food and its manner of attaining it. We should start, however, with examining the geography of a typical beak, the structure from which all modifications have started.

The bones of the beak are so bound up with the bones of the skull that to enumerate the one without the other is valueless while the bones of the palate are of great importance in classification; to enumerate the lot is hardly worth while here, as any serious student of the subject would need something far more exhaustive than this paper. I will content myself with saying that full details may be found in Professor Newton's valuable *Dictionary of Birds* and proceed forthwith to enumerate the ordinary external features of the beak.

The beak, as we see it, consists of an upper and lower half; the former consists largely of the pre-maxillary and maxillary bones and is often termed the maxilla. The lower half is known as the mandible. In popular phraseology it is customary to speak of the two halves as the upper and lower mandibles. Their point of junction at the base is known as the gape and their cutting edges the commissure. The high central line of the upper mandible, often marked by a ridge, is the culmen. (Plate C, fig. 1.) The bare skin which encloses the nostrils in birds-of-prey, owls, parrots and pigeons is the cere. (Plate C, fig. 2.) In the gulls a conspicuous angle appears on the lower surface of the lower mandible, marking the junction of the two sides; this is known as the gonys..

The horny covering moulded largely on the shape of the bones and producing many of the conspicuous features of the bill is known as the *rhampotheca*; it is akin to those other horny structures the claws, nails and spurs, and to the scales on a bird's feet.

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[1] Beak and bill appear to me to be synonymous terms and I have used them as such without distinction of meaning.

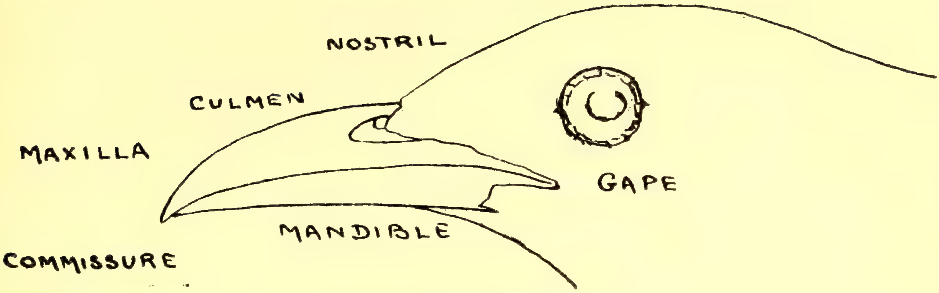
NOSTRIL
CULMEN
MAXILLA
GAPE
MANDIBLE
COMMISSURE

FIG. 1.—The beak of a bird

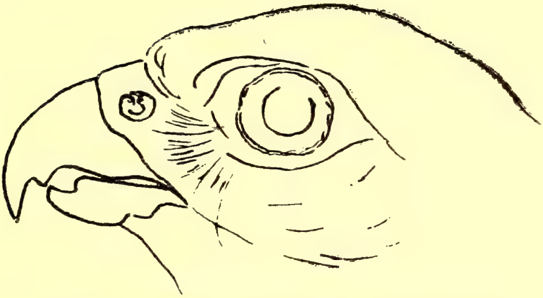

FIG. 2.—Head of a Falcon to show the cere

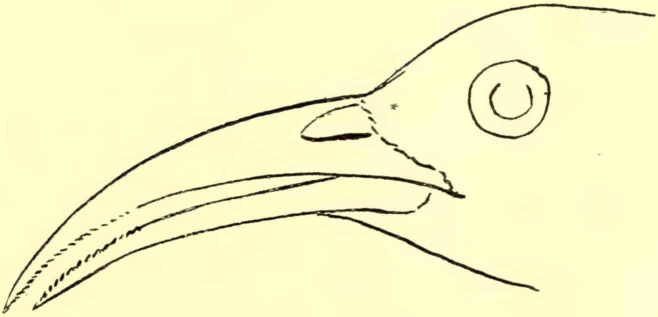

FIG. 3.—The beak of a Sunbird enlarged to show serrations

BEAKS OF BIRDS

The horny covering of the bill as a rule forms a coherent sheath separate for the two mandibles. Examine the decaying corpse of a bird and you will find that the whole of the beak, as we see it, slides off into the hand leaving the bones all exposed to view. In some groups of birds, however, such as the Gannets and Cormorants, in the Ostriches and Tinamous, and in that common Indian bird the Night Heron (*Nycticorax nycticorax*) the *rhampotheca* consists of separate horny plates, and we have already seen in our discussion of the ancestry of birds that these plates are considered to represent certain types of reptilian scales on their corresponding parts. To quote Professor Thompson :—'This illustrates a frequent *method of evolution*—making a new thing, in this case the sharp edged horny bill, out of a very old thing, in this case the scales of the reptile's jaws'.

The development of the *rhampotheca* in various directions provides the bird with its various substitutes for teeth, a use that is paralleled amongst the Turtles and the Tortoises which have the horny covering of their jaws similarly used to provide cutting edges. Before proceeding to examine the ways in which the *rhampotheca* is so adapted one must recall the fact that teeth have two main purposes. They not only cut off the food into appropriate portions but they also masticate it. The birds beak is used to fulfil the first of these purposes and it does so most efficiently, but it is very seldom used for actual mastication. That function is provided for by the gizzard, the posterior portion of the stomach which is unprovided with digestive glands and works merely by mechanical muscular effort to prepare the food for the action of the digestive secretions in the intestines; as is well-known, most birds swallow a certain quantity of small stones and grit, which mixes with the food in the gizzard, and ground together by the action of the muscular wall further assists in its mastication. The compound muscular stomach is a peculiarity of birds.

The use of the horny covering of the beak as a substitute for teeth is attained in several ways. The most universal is of course that of the cutting edges of the beak, a use so universal and obvious that it need not be lingered over; it is present more or less even when the following more interesting modifications are present.

Of these the most obvious is the lengthening and turning over of the tip of the beak to form a piercing or tearing point. This form of beak is well known as the special characteristic of those large and conspicuous groups, the Birds of Prey and Owls and the Parrots. It is interesting in this connection to notice two points; first of all that the one group is flesh-eating and the other vegetarian; that is to say this type of beak has been evolved not with reference to a particular class of food, but simply with reference to food which needs a particular type of treatment—food that cannot conveniently be swallowed whole, and food that is exceedingly hard to tear to pieces. Watch a hawk tearing up a small mammal or bird and you will see the immense muscular effort involved in the process, and the splendid adaptation of the tool with which the work is done; or watch a parrot gnawing a brazil-nut and you will see a similar perfection of the adaptation of an organ to its work.

The second point is that we see a perfect example of the fundamental law that similarity of form does not denote relationship. The two classes of birds in question are not nearly related in the scheme of classification; they share a form of beak found hardly elsewhere in the whole world of birds, yet it denotes nothing more than that both feed on food that requires similar treatment; while those foods themselves are inherently and widely different.

Even so, Nature's laws are seldom rigid. The Lories share the beak of the Parrot order yet feed almost entirely on soft foods; and many other orders are able to feed on fruit without this special form of beak.

While the full development of this type of beak is limited to Birds of Prey, Owls and Parrots, an approach to it may be met with in other forms. A familiar example is that of the Shrikes (*Laniidæ*) and here again we find that the Shrike is accustomed to feed on prey that he needs to tear up, with difficulty. The Shrike is a miniature bird of prey in his fondness for small birds and mammals and large insects. Without a tearing flesh-hook he could not break them up. But because nature did not provide him like the parrots, hawks and owls with the necessary adjunct, the strong grasping feet and claws to hold the food firmly whilst it is being torn, he has had to use his brains and find a substitute. The food is hung on to a thorn and so held whilst it is being torn, with the further corollary when hunting is good that the thorn-tree becomes a storehouse or 'larder'.

Although it is not an Indian bird I cannot refrain from mentioning the case of the Kea (*Nestor notabilis*), a large parrot found in the Southern Island of New Zealand. This parrot has been provided with the typical hooked beak and its real food is of a vegetable nature as with all others of the family. Yet with the arrival of the colonists and the introduction of their sheep it has discovered that a beak provided for the tearing and gnawing of vegetable food is equally good for the tearing of flesh; it has learnt to assault sheep and picking holes in their sides wounds the intestines and causes death. How far this action is the result of deliberate intention and how far the bird profits by the resulting supply of meat is unknown to me; I merely quote the case to emphasize my previous assertion that the one type of beak suits two very different foods. Whilst as a final reminder that similarity of form does not betoken relationship I would remark that in the octopus a very similar type of beak has developed in response to its predaceous habits.

Another form of modification of the horny sheath of the beak to supply the lack of teeth consists in serrations along the commisure, the cutting edges of the mandibles. In their most undeveloped form they consist of mere indentations along the edge; these may consist of a single pair as in the Falcons, a mere reinforcement of the tearing point of the beak, or even simply of a sinuous curve (known technically as a 'festoon'). In the Toucans the serrations are more numerous. In India we are more familiar with the case of the Flower-peckers (*Diœidæ*) and the Sun-birds (*Cinnyridæ*), though as both these families consists of tiny birds the line of close serrations which occur on each of the four inner edges of the beak are very minute and are more easily perceived by touch than sight. (Plate C, fig. 3). It is commonly assumed that these serrations are intended to secure a firmer hold on the food; though if that is the correct explanation it still remains to be shown why these two families alone require it out of the great body of Passerine birds in India. The point requires investigation. That serrations may often be intended to secure firmness of grip will, I think, be clear to anyone who examines the tip of the beak of a Little Bittern (*Ixobrynchus*) in connection with its food and manner of feeding.

This type of serration, presumed to be to secure a firmness of grip, finds its maximum of development in that curious bird the Darter (*Anhinga melanogaster*) which is perhaps one of the most expert swimmers and divers in the world, pursuing and catching fish under water. In this case the serrations have become a series of fine needle-like points and these must be intended to secure the grip of a very slippery and elusive prey, caught in its own element by sheer superiority of movement.

The system of serrations finds however its most wonderful development in another direction, when it becomes a sieve or strainer for birds that find their food in water or mud, that food being usually of a minute character. As in the case of the Parrots and Birds of Prey the sieve has been developed in unrelated orders.

In this type of beak we find that the horny edges of the mandibles have become not merely serrated, but the serrations are produced into definite lamellæ or plates, roughly speaking like the teeth of a comb. At the same time the tongue has become a large and fleshy organ also fringed with horny processes. Tongue and beak together form a most elaborate strainer. We are all familiar with the characteristic habit of the domestic duck which 'puddles its beak' incessantly in mud and water, and if we watch it carefully we shall see that it is simply using this strainer to capture food, the soft mud and water being put through the sieve leaving behind in the mouth the required food. The degree of development of this strainer varies in the whole of the *Anseres* (Geese, Swans and Ducks) and will be found correlated with their feeding habits. It is least developed in the Geese which obtain most of their food by grazing and its maximum development is in that common Indian duck the Shoveller (*Spatula clypeata*) whose bill has been widened and flattened to accommodate the tremendous combs of lamellæ. (Plate D, fig. 4). Small wonder is it that the Shoveller is of small account amongst sportsmen who complain that it is found in the dirtiest of village ponds and that its flesh has a rank and muddy taste. Nature has specialised the Shoveller to feed where there is less competition from other ducks, and the very success of his side-line has cut him off from many of the cleaner foods that other ducks enjoy. How little importance in classification, that is the expression of descent and relationship, are the most conspicuous features and developments is most clearly shown in this development of the beak as a sieve; for in addition to meeting it again in other families, we find that it is not even universal amongst the *Anatidæ*. The Mergansers and Smews, which occur in winter in Northern India are diving ducks which normally pursue and catch fish under water. The serrations along the edge of their beaks have not become a sieve; they are developed into sharp spikes, for all the world like teeth, directed backwards so that there is little hope of escape for any fish once caught in the beak, save headlong down the gullet.

To return to the sieve: it is found again in other forms in two well-known Indian birds, the Flamingo (*Phœnicopterus*) and the Open-bill (*Anastomus*), in each case connected with other remarkable peculiarities of structure—these last, due in all probability to the fact that their possessors are long-legged birds and not like the *Anatidæ* close to the element in which the sieve is employed. (Plate D, fig. 5).

The edges of the beak of the Flamingo are well-furnished with the sifting lamellæ; in addition the two halves of the lower jaw are considerably enlarged so that the upper jaw closes into a wide cavity; in other words the normal relationship and fitting of the two jaws is practically reversed, a point which becomes intelligible when it is understood that in feeding the Flamingo reverses the usual position of the bill, assisted thereto by the fact that the whole bill is bent sharply downwards; in short when the Flamingo feeds its head is upside down, an attitude which allows the mud and water to be sieved in spite of the extremely long neck and legs; otherwise the long neck would have had to be of ungainly length to secure the necessary proportion with the legs, to allow use of the sieve.

In the Open-bill (*Anastomus oscitans*) the sieve is in the shape of a dense brush-like mass on the inside of the pre-maxillary region of the upper mandible. The great peculiarity of the beak is however that the mandibles do not shut properly (to speak popularly); when the beak is closed there is a gap in the centre, as both mandibles are curved. There has been much speculation over the meaning of this gap and it is usually said to be due to wear as the bird feeds on molluscs and breaks the shells with its beak. I have not had sufficient opportunities of meeting this bird in life to speak positively as to its feeding habits, but cannot help wondering whether the old name of Shell-Ibis has unconsciously affected the usual estimate of its food. Large molluscs are undoubtedly eaten but the staple food must be connected with the sieve, and I imagine that the open beak is connected with the unusual position of the sieve and is merely another device, like the Flamingo's, to let a long-legged bird use its sieve in water; that the beak instead of being used parallel with the water, is plunged in point downwards, the water being taken in through the gaps and expelled through the sieve at the tip of the bill. This would still allow fresh water mollusca to be the principal food, as they are abundant and minute. Many of our members have opportunities of watching the bird and should soon be able to settle the point. I make no apologies for doubting the established theories on the point, remembering how it is only a year or two since Major Hingston with a little observation in the field settled the parallel

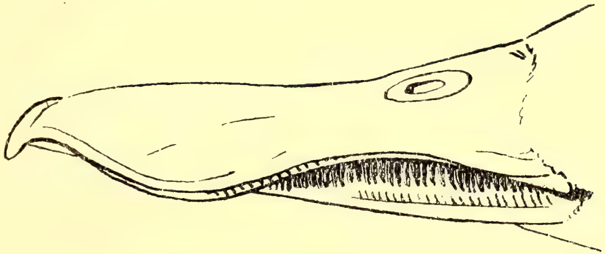

FIG. 4.—Beak of the Shoveller

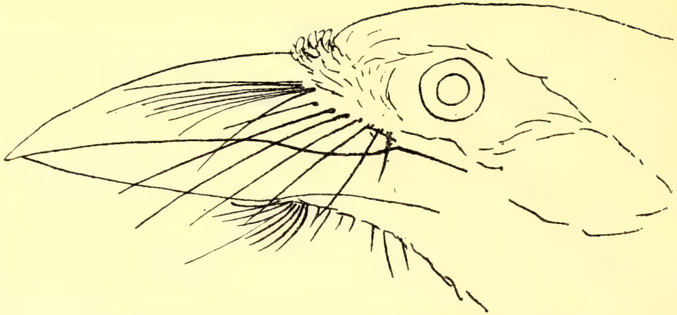

FIG. 6-A.—Rictal bristles of a Barbet (side view)

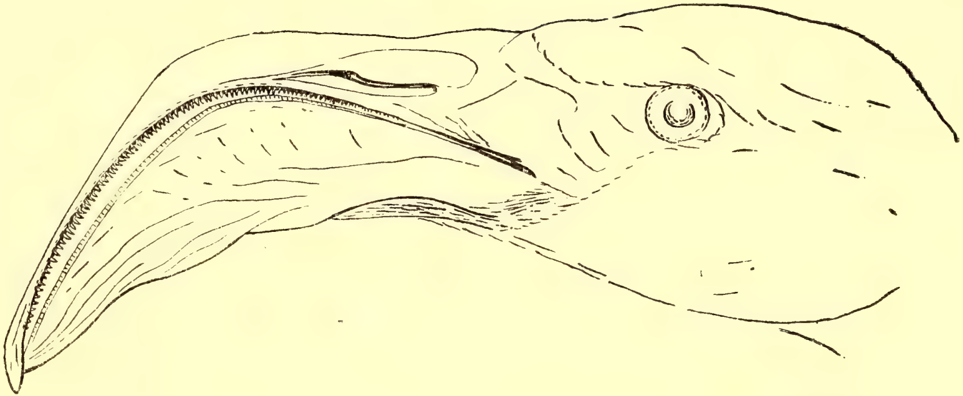

FIG. 5.—Beak of the Flamingo reduced to $\frac{7}{9}$ natural size

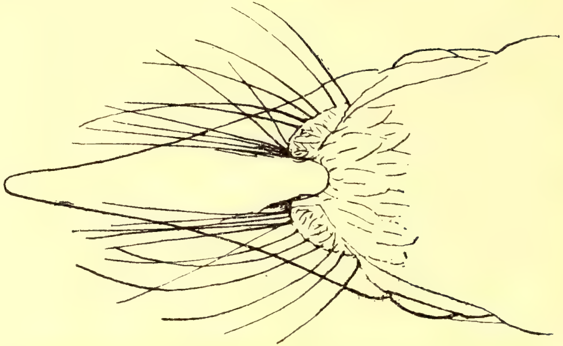

FIG. 6-B.—Rictal bristles of a Barbet (from above)

BEAKS OF BIRDS

mystery of the curious beak of the Scissorbill, which I shall presently describe.

We found the beak of the Parrots and Birds of Prey had been developed for similar uses by the Octopus. The sieve of the *Anatidæ* and the Flamingo is found again in the 'whale bone' of certain whales; with it they strain the sea water for the minute organisms that comprise their food.

Finally there is another form of development of the beak which may be considered as a substitute for some of the uses of teeth. In this pads and bosses of horny structure are developed either on the edges of the *rhampotheca* or inside the mouth on the palate.

The Hawfinch (*Coccothraustes*), for example, according to Pycraft, has on the horny sheath of the lower mandible a pair of tumid swellings with serrated surfaces and they work against a large cushion of similar structure borne by the palate, the whole forming a regular crushing and grinding mill. The Hawfinch is a rare bird in India, confined to the extreme north-west, but we have several allied Grosbeaks (*Mycerobas and Perisosspiza*) and even the little Munias (*Uroloncha*) whose conical heavy bills are intended to crush. In the Grosbeaks we find developments at the gape which enable these birds to crack wild cherry-stones with the greatest ease, and some idea of the tremendous force exerted can be seen by a mere inspection of the appropriate muscles. These attain their greatest development in the Spotted-winged Grosbeak (*Mycerobas melanoxanthus*), the muscles covering the whole of the cranium and even affecting the bony structure by the necessities of their attachment.

The presence of internal bosses and ridges is found also in the Parrot and this helps to account for the ease with which they open the hardest nuts. Examine any of our Indian Parrakeets and the lower mandible will be found to end in a transverse blunt edge, which presses against a corresponding horny prominence of the upper beak, behind its tearing hook; whilst in various species of the family this prominence is reinforced by transverse horny ridges, like those of a file; these serve more than one purpose. They help to hold and to crush a nut or seed, and they are also used to file and sharpen the tip of the lower mandible, an action in which any captive parrot may be frequently seen to indulge.

In an earlier chapter I have already emphasised the fact that true teeth exist in no existing species of bird; and the so-called 'egg-tooth' has already been described. It only remains therefore to remark about the *rhampotheca* that it is capable of renewal and that it is not necessarily hard.

There is continual wear on a bird's beak, either in the normal actions of feeding, or in some species like Woodpeckers and Kingfishers through the use of the beak as a tool. This wear is reinforced by constant growth, and curious malformations of the beak are common when wear has not kept pace with growth, especially as a result of captivity. At Phillaur, Punjab, I shot a starling (*Sturnus vulgaris poltaratzskii*) in which the beak had attained a length of 44 mm., as compared with the normal length of about 30 mm., and more marked examples are found in every museum.

Crossed and curved mandibles also occur, but they are naturally not commonly seen, as their presence must cause mortality.

Growth of the horn from the base of the beak and wear from its tip and edges serves as a substitute for the moult of feathers and reptilian scales, but cases of literal moult of the horny covering do occur.

In the Puffin (*Fratercula arctica*) and several allied species, as is well known, a regular breeding adornment of a brightly coloured sheath to the beak accompanied by horny excrescences above the eyes and at the gape is assumed in spring and moulted again in autumn, while in one of the American Pelicans (*Pelecanus erythrorhynchus*) a triangular compressed horny excrescence is assumed on the beak and moulted again after the breeding season. It is possible that some such example may be discovered amongst our Indian birds.

Before leaving the subject of the *rhampotheca* I may remark that whereas it is normally hard, in some cases it may be soft. This is usually about the area of the nostrils and produces the familiar 'cere' of parrots, owls and birds of prey (Plate C, fig. 2), and the curious tumid powdery-looking swelling of the nostrils of pigeons and doves. Occasionally, however, almost the whole of the beak appears soft, as in the case of geese.

The gape is the name given to the angle of the mouth at the apparent junction of the two mandibles, where a fold of tough skin marks the limit of the opening. In adult birds it is not particularly conspicuous but in the nestlings of nidicolous[1] birds it is usually tumid and conspicuous if not also curiously coloured and ornamented.

Now the whole subject of the mouths of nestling birds, for the palate as well as the gape may show conspicuous colours and markings, is a difficult one which is not yet fully understood. Mr. C. F. M. Swynnerton has attempted a study of the subject in the case of the African birds (*Ibis,* 1916, p. 264 *et seq.*) and it would be well if some of our keen bird-nesters would read this paper and attempt to carry on similar investigations in India. The usual theory is that these markings are intended as a guide to the nestling's mouth in the dark interior of the nest, so that the parent may quickly place the food in the right place. The necessity for such a guide seems hard to understand when we know that the parent has a keenness of sight sufficient to enable it to secure an unending supply of minute seeds and insects and their larvæ and eggs. Mr. Swynnerton is of opinion that these colours and markings are more of a warning and a deterrent to possible enemies, though this seems equally hard to believe. That the gape should be swollen and therefore conspicuous is easily explained by the mere physical fact that it is the point of greatest weakness in a young bird's mouth, the point which, unless fortified, might easily be split by the continual entry of the parent's beak with food.

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[1] As opposed to, nidifugous birds which leave the nest as soon as they are hatched, and are able to pick up their own food.

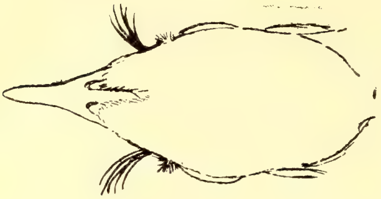

FIG. 7-A.—Rictal bristles of *Chætornis* (from above)

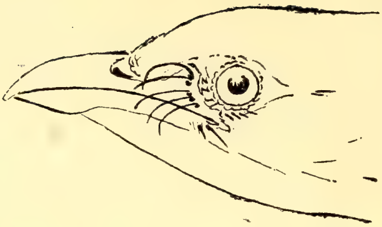

FIG. 7-B.—Rictal bristles of *Chætornis* (side view)

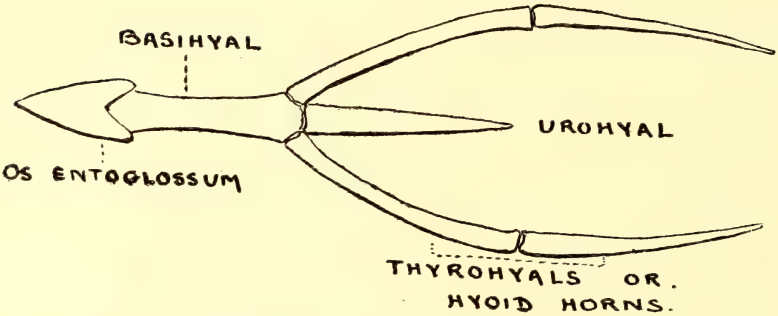
BASIHYAL
UROHYAL
OS ENTOGLOSSUM
THYROHYALS OR.
HYOID HORNS.

FIG. 8.—Bones of the Hyoid apparatus

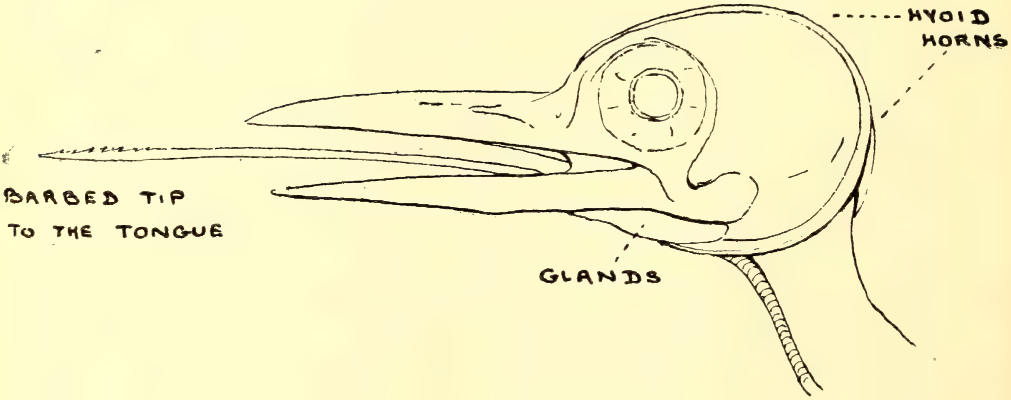
HYOID HORNS
BARBED TIP TO THE TONGUE
GLANDS

FIG. 9.—Head of a Woodpecker to show the position of the tongue

That common and otherwise dull little bird, the White-throated Munia (*Uroloncha malabarica*) furnishes a good example of mouth markings, and might serve as a starting point for an investigation into the whole subject.

The gape or rictus naturally leads to mention of the rictal bristles, which to a greater or lesser extent fringe the base of the beak from culmen to the gape. Their development varies greatly, but as a rule they are most highly developed in insectivorous groups. In both the Nightjars (*Caprimulgidæ*) and the Flycatchers (*Muscicapidæ*) which habitually chase insects on the wing it is usually suggested that their presence is intended to increase the catching area of the mouth, an inference which seems irresistible when one opens the enormous mouth of a Nightjar and notes how the bristles continue its lines. But that this can be their only purpose is negatived by their great development in some fruit-eating birds like the Barbets (*Capitonidæ*). (Plate D, fig. 6 A. & B.).

My own impression is that the primary function of the rictal bristles lies in the protection of the eye, for eyelashes are found in very few birds, and this view receives confirmation by the case of the Bristled Grass-warbler (*Chætornis locustelloides*). The Fauna remarks badly: 'The genus *Chætornis* is characterised by having unfeathered lores with five exceptionally strong rictal bristles arranged in a vertical row in front of the eye.' From the dry skin one would never appreciate the fact which I discovered accidently in the field that these five bristles are set in a loose moveable flap of skin—hence the bare lores, for feathers would not be compatible with this movement—so that the five bristles move on a hinge backwards and forwards, and when pressed back cover the eye completely with a grating. The value of this to a small bird which skulks perpetually in heavy grass must be obvious. (Plate E, fig. 7 A. & B.).

The nostrils of a bird exhibit much variation, both internally and externally. There are two main types of nostril known as the *nares imperviæ* and *nares perviæ*, according to the presence or absence of a complete vertical *inter-nasal septum*. The septum or wall between the two nostrils may be composed of either cartilage or bone. When the septum is present and complete the two nostrils are entirely separate, forming the condition known as *nares imperviæ*. When the septum is incomplete the two nostrils communicate with each other and are *nares perviæ*. The two types of nostril appear to be somewhat capriciously distributed amongst the natural orders; for instance to quote a well-known example our Vultures in India (*Vulturidæ*) have *nares imperviæ* while the other condition is found in the Vultures of the New World (*Cathartidæ*).

Externally the nostril may appear as a simple hole or slit, sometimes covered with a leathery operculum or valve, sometimes naked and visible or sometimes covered with a dense mat of feathers or naral bristles. In the Nightjars (*Caprimulgidæ*) each nostril is produced into a short soft tube. In the Petrels and Albatrosses (*Tubinares*) each operculum forms a regular tube which may or may not fuse with its counterpart in the middle line, and thereby produces the appearance of a single tube along the top of the culmen. In the Gannets (*Sulidæ*), on the other hand the external nostril is entirely closed, the inner openings of the nostril being very large and communicating directly into the mouth. The value of this arrangement is easily suggested to anyone who has seen the vigour of the Gannet's dive in the roughest of seas, yet our Indian Pied Kingfisher (*Ceryle r. leucomelanura*) dives as well without it. The reason for most of the variations in bird's nostrils is clearly still unknown to us. Birds as a class are believed to have little or no sense of smell.

The tongue of a bird is often greatly affected by the purpose and modifications of the beak. Its structure is typically very easy to understand, bearing the collective name of the Hyoid apparatus. This diagram (Plate E, fig. 8) explains the arrangement of bones (or cartilages) forming the framework of an ordinary bird's tongue; it need only be explained that the arrow-headed *os entoglossum* is the basis of the tongue proper which we see on opening a bird's beak; while the urohyal rests on the larynx and is attached to it. The Hyoid horns lie backwards under the base of the skull. The Hyoid apparatus varies a good deal in shape, proportions and in the presence or absence of certain parts and is undoubtedly of taxonomic value. I will confine my remarks however to the variations commonly visible in the tongue itself, without dissection.

The variations in bird's tongues are endless, both in form and size, and greater than in any other class of vertebrates. They are used apparently not so much as an organ of taste or touch, but to assist the beak in the management of the food.

In certain birds such as the Gannets (*Sula*) and the Cormorants (*Phalacrocorax*), the tongue is a mere degenerate vestige and Pycraft explains this by the fact that the food (fishes) is bulky and swallowed whole, and therefore a tongue of ordinary proportions would merely be in the way. Unfortunately, however, for this theory a similar condition of degeneracy is found in such widely unrelated birds as the Nightjars (*Caprimulgus*) and the true Storks (*Ciconia*), whose food is the reverse of bulky, so that it is evident that this explanation is not satisfactory. The smallness may be due to mere atrophy, Nature's usual penalty for the disuse of an organ.

That the shape and size of the tongue is connected with the feeding habits, in some way or another, is clear from numberless instances; to quote a most suggestive one, we may take the case of the Flamingo (*Phœnicopterus*). Now the Flamingo is merely an aberrant stork and the true storks have no tongue at all to speak of; yet we have already seen how the Flamingo feeds not like a stork but like a duck, and has to that end a beak that is in essentials a sieve like a duck's beak. A duck's tongue is extremely thick and fleshy, fitting the whole cavity of the beak and fringed along its edges with fine horny or fleshy processes complementary to those of the beak. So is the tongue in the Flamingo.

In the majority of birds the tongue is comparatively small, horny at the tip and with the back armed with small pointed processes directed towards the gullet. The function of these processes is evidently to direct the food into the gullet. In the Birds of Prey and the typical Parrots, whose beaks we found such perfectly developed implements for handling difficult food the tongue becomes thick and fleshy, with the tip sometimes hollowed into a sort of spoon. This hollowing of the tip seems to be very definitely connected with the holding of the food in place for the operations of the beak, for we find it again in the heavy-beaked finches of the Hawfinch and Grosbeak type which split strong seeds and fruits by a mixture of skill and strength, while in the Crossbill it is known to be connected with the extraction of seeds from the cone.

In the Lories, on the other hand, which feed on soft fruit and nectar the tongue has become a regular brush and to it is due their other name of Brush-tongued Parrots.

Lack of space prevents mention of more than two other important forms of tongue, and both these are extensile, a condition rare amongst birds as a whole; both are intimately connected with the obtaining of food.

In the Woodpeckers (*Pici*) the tongue is very long, thin and pointed, and the bones of the Hyoid horns are similarly lengthened to such an extent that to accommodate them they have to curl round the base of the skull over the top of the head to the base of the beak, lying just under the skin. (Plate E, fig. 9). The pointed tip of the tongue is coated with a sticky saliva furnished by two large glands which lie near the base of the tongue. The length of the Hyoid horns forms a kind of spring which enables the tongue to be extruded and retracted very rapidly and there is no doubt that this sticky tongue is used for the capture of small insect food. How far the tongue is used to draw food from burrows and crevices in trees, and how far its maximum development will be found amongst those Woodpeckers whose food consists chiefly of ants is a matter that still requires investigation. That a similar modification of tongue is found in ant-eating mammals is suggestive, as also is its absence in the sap-sucking Woodpeckers (*Sphyropicus*), of America whose tongue is virtually made into a brush by the short hair-like processes on each side near the tip. There is a good deal of difference in the degree of development of the tongues of our large selection of Indian Woodpeckers and it merits study in connection with their varied habits.

In a large number of birds the tip of the tongue is split into several minute fronds, often so numerous as to become practically a brush, and this development appears to be largely connected with insect or semi-liquid foods. In the Sunbirds (*Nectarinidæ*) it is found in conjunction with a rolling up of the edges of the tongue until it has become a regular tube, extensile and connected in some way with the extraction of food from flowers, whether nectar or insects. Careful field observations are badly needed on the feeding habits of our Indian Sunbirds and I feel sure that they would reveal a great deal of information in connection with the peculiar structure of the beaks and tongues of this group and also of their importance in the life histories of many Indian plants.

Before leaving the subject of the tongue I may emphasise the point that it has no connection with a bird's voice or song. They are produced in the Syrinx or lower Larynx and the barbarous practice of splitting a bird's tongue in order to make it sing or talk better is therefore entirely pointless, as is the Lucullan idea of a dish of Nightingale's tongues, being sweeter for the song.

The specialised tongues of the Woodpeckers go with a specialised type of beak, which may be described as a chisel. This is meant for cutting wood and it does so most satisfactorily, worked as a chisel with incessant blows (for hammer and chisel are here necessarily combined) or as a gouge. With the beak rotten wood is cut away, holes are opened and bark is chipped off, preparing for the specialised tongue to function as the food is laid bare. Most unusual perhaps of all the beak is also a drumstick. The Pied Woodpeckers of the genus *Dryobates,* in particular, definitely drum as an outlet for sexual emotion, vibrating the beak rapidly with a quick succession of blows on a dead bough. The chosen bough is used again and again for the purpose and this drumming undoubtedly performs the function of a song and is its substitute.

Amongst the definite types of specialised beak found in India must be reckoned that of the Hornbills (*Bucerotidæ*), with the several species. (Plate F, fig. 10). There has been much speculation as to the purpose of this casque which, if cut open, is found to consist not of solid horn but of a mass of bony props and tissues with numberless open cells between them. Now an examination of the whole structure clearly shows that it is in the nature of a shock absorber, and the belief has arisen that the casque is used as a hammer to break open nuts. In what attitude the bird could break nuts with its casque has never been explained. From what I have heard of captive Hornbills I feel sure that the whole beak is used literally as a pickaxe or adze and that the casque is merely a means of absorbing the resultant heavy shocks and so preventing injury to the brain. That the Hornbills throw most of their food in the air and catch it before they swallow is merely a result of the fact that the beak has been specialised to form a heavy tool and so is inconvenient for the lighter work of directing food up its length.

These general aspects and lines of development of the beak which we have been considering are all connected with its primary use in connection with food. It must be remembered, however, that the beak has a secondary and indirect function. It has to take the place of the hand.

A very few birds are able to use the foot to a limited extent as a hand. This ability is most marked amongst the Parrots and Parrakeets who habitually hold the food up in one foot while it is being eaten. I believe that very occasionally some of the Owls and Shrikes may do the same thing but very few birds even attain to the fairly obvious method of holding food on to a perch with the feet and pecking at it down in that position.

Using the foot to carry food or nest material is almost equally rare. The birds of prey, diurnal and nocturnal habitually carry food or sticks in their talons and one or two of them even use one foot to carry the food to the beak in flight (though they have not attained the parrot's gift of doing this when perched). The most

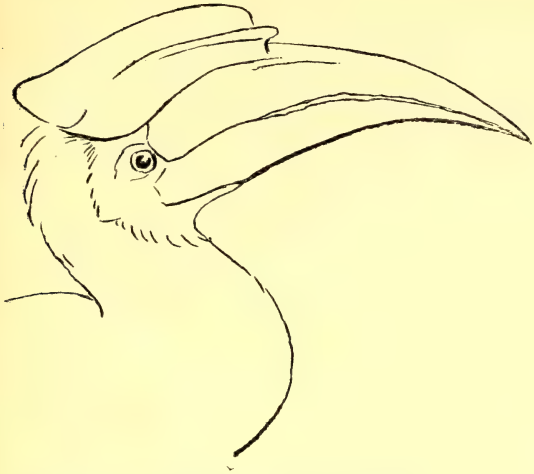

FIG. 10.—The casque of the Hornbill
(*Dichoceros bicornis*)

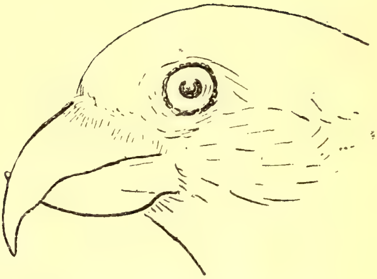

FIG. 13.—Beak of the Crossbill

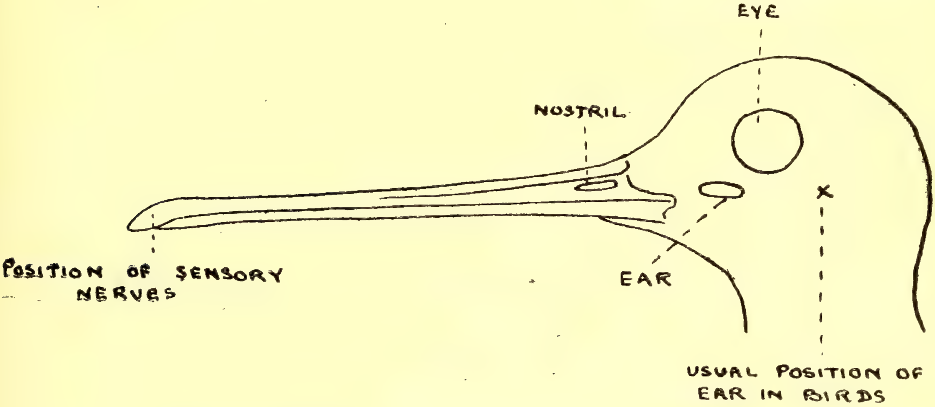
EYE
NOSTRIL
X
EAR
POSITION OF SENSORY NERVES
USUAL POSITION OF EAR IN BIRDS

FIG. 11.—Diagram to show position of the ear in Snipes

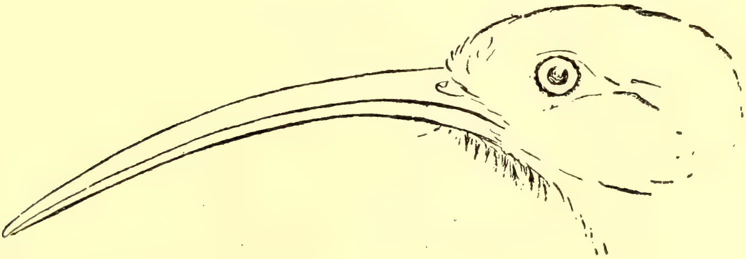

FIG. 12.—The beak of the Slender-billed Scimitar Babbler
(*Xiphirhamphus*)

Beaks of Birds

familiar example of this is the common Pariah Kite (*Milvus m. govinda*) who feeds in mid-air, biting fragments from the food held in the foot which is stretched forward to meet the beak. The Hobby (*Falco subbuteo*) is said to do the same thing but I have never personally seen it do so, though I have had many opportunities of observing the species.

Twice I have seen a House Crow (*Corvus splendens*) carry a stick grasped in both feet, but the awkwardness with which it did so, the legs hanging low below the body, confirmed the unusualness of the act. The manner in which the Woodcock (*Scolapax rusticola*) transports its young between its thighs has often been described.

With a few exceptions of this type, the beak has to do all the functions of the hand in birds. It carries the nest materials and builds the nest, often a piece of most intricate workmanship; it carries the food to the young and cleans out their excreta; it preens the feathers; it is far more useful an organ than any of the other natural orders possess and it is second only to the hand.

Depending as it does on feeding habits for its form the beak exhibits little or no sexual dimorphism. The classic example of sexual dimorphism in the beak is that of the Huia-bird (*Hetarolocha acutirostris*) of New Zealand. In this species the beak of the male is short and but slightly curved, while that of the female is rather more than twice as long and much decurved. These birds live on wood-boring grubs and it is believed that the male reaches these by chiselling away the rotten wood while the female probes for and extracts those ensconced in the sounder portions of wood, too hard for the male's method of attack. We have no such example of dimorphism amongst Indian birds so far as form is concerned. A moderate degree of sexual dimorphism in the colour of the beak is common, and a seasonal dimorphism of colour is often found, as for instance in the Sparrows (*Passer*).

This completes our general review of the beak and its attributes. It will, however, be of interest to remark on a few of the other very highly specialised beaks that we meet with in the rich Indian avifauna.

One of the most obvious ways for a beak to attain specialisation is in the direction of length and slenderness to enable the owner to extract food from a hiding place, whether in a crevice amongst stones or bark, from the interior of a flower, or from mud or water. To this end the beak has to be used either as a forceps or a probe, the former being far the commoner use. In such a beak a curve is of distinct utility as it saves the neck from the extra contortions and strain which would be necessary when the food was found in all but the most straightforward positions. In the majority of cases therefore a long thin beak has also a downward curve; a Sunbird, a Tree-Creeper and the Curlew are instances which readily occur to the mind—occasionally however the curve is upwards, though this is rare, and it is confined to long-legged water-birds such as the Greenshank or the Avocet which take their food from soft mud and water. The probing type of beak on the other hand is best straight.

The Godwits (*Limosa*) and the Snipes (*Capella*) afford the best examples of the use of the beak as a probe. Its development is highest in the Snipes and Woodcocks where there are several modifications of importance. To begin with the tip of the beak is furnished with an extremely sensitive arrangement of sensory nerves. To quote from Yarrell: 'The end of the beak of the Snipe, when the bird is alive, or if recently killed, is smooth, soft and pulpy, indicating great sensibility; but some time afterwards it becomes dimpled like the end of a thimble. If the upper mandible be macerated in water for a few days, the skin, or cuticle may be readily peeled off. The external surface then presents numerous elongated hexagonal cells, which afford at the same time protection, and space for the expansion of minute portions of nerves supplied to them by two branches of the fifth pair; and the end of the bill becomes, in consequence of this provision, a delicate organ of touch, to assist these birds when boring for their food in soft ground; this enlarged extremity of the beak possessing such a degree of sensibility as to enable these birds to detect their prey the instant it comes in contact with it, although placed beyond the reach of sight.'[1]

It is not, however, sufficient that the Snipe should be aware that there is food down in the ground at the end of its beak; it has to seize that food and the effort involved would be very great if the beak had to open for its whole length with the implication of shifting the mass of surrounding soil. A mechanism has been involved whereby only the tip of the beak is opened sufficiently wide to grasp the food. The mechanism is simple, and is thus described by Pycraft: 'The beak of the Snipe is formed by the elongation of the premaxilla and the extension forwards of the naral fossa to within a short distance of the tip of the beak. Thus is formed an upper and a lower pair of lateral rods of great slenderness and elasticity. By the contraction of muscles attached to the quadrate bones the pair of inferior bars are thrust forwards, and this results in forcing the tip of the beak upwards. The relaxation of the muscle brings the curled up tip down again so as to close on the worm and hold it securely until brought to the surface.'[2] Some idea of the perfection of this mechanism is gained from Mr. F. Norwood's statement, made on observation of a captive Woodcock, that 'the flexibility of the upper mandible of the bill was so great that it more resembled the writhings of a worm than a beak.'

So highly important are these specialisations in the economy of the Snipes and Woodcocks that the apertures of their ears have shifted from the normal position forwards to in front and below the eye, that is near the base of the beak: and it is clear that this is in order to reinforce the sense of touch with the sense of hearing while the long beak probes for its subterranean food. (Plate F, fig 11). It is interesting to remark that another bird which feeds chiefly on earth worms—though it is not Indian and belongs to a very different order to the Snipe—has not its ear but its nostril entirely shifted to aid in the search for its prey. In the Kiwi or Apteryx of New Zealand the nostril is at the tip of the long bill.

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[1] Yarrell, 'British Birds', 4th edition. Vol. III, p. 346.

[2] 'A History of Birds', p. 414.

The use of a long beak as a forceps is so obvious and straightforward and so common that I need not labour examples of it. But it is well to remark on the extreme example of it which we meet with amongst Indian birds, in the Slender-billed Scimitar-Babbler (*Xiphiramphus superciliaris*). (Plate F, fig. 12). A glance at my illustration will show the disproportionate looking size of the beak in this species, one of the most marked amongst all Passerine birds. To our shame we have to admit our ignorance of the reason for this extreme specialisation in one member of the large group of Babblers and Laughing-Thrushes. There must be some particular reason for it connected with some special feeding habit and I would hazard the guess that the bird feeds particularly at some special flower and is the means of its fertilisation. I can trace no note on its feeding habits except that Meinertzhagen (*Ibis*, 1927, p. 575) remarked that near Darjeeling a pair used to vist a Red Cotton-tree in bloom and studiously probe the flowers.

The most extreme comparative length of bills occur amongst the Humming-birds of the New World, but their long bills cannot be regarded as of the forceps type; they serve more as sheaths for the tubular tongue through which food appears to be largely taken by suction.

In a few birds the beak may serve the purposes both of a probe and a forceps, and of this type the Hoopoe (*Upupa epops*) may well serve as an illustration. It is equally skilful at extracting grubs from the interior of the earth or picking beetles from its surface.

Breadth of bill is another method of attaining specialisation and there are various devices by which breadth is attained without too great a weight which would disturb the balance of the bird. A broad bill is generally not broad for its whole length. A very broad gape with the bill tapering rapidly to the point is the normal way in which undue weight is avoided; and as we have remarked above the fringing of the gape with long rictal bristles doubles the breadth without increasing its weight. A beak of this type is the obvious instrument for the capture of living insects and we see it in several totally unrelated families, such as Flycatchers, Swallows, Swifts and Nightjars, its perfection of development occurring in the last named (*Caprimulgidæ*). There are two special points of interest however. This type of beak carries the obvious corollary that the captured insect must pass straight into the gullet and therefore the food must consist of insects which are unprotected with stings and such as are easily swallowed. A Swift therefore does not capture bees, and butterflies are fairly immune from these types of insect feeding birds for the simple reason that their large wings would prove rather a stumbling block to rapid feeding methods.

It will be remarked that the Bee-eaters (*Meropidæ*) which habitually catch bees and wasps on the wing have the wide gullet protected by a long sharp pointed beak; the insect is captured in the point of the beak and rendered innocuous before it is swallowed. Specialisation seldom affects only one part of an organism. Shortness of beak appears to be a necessity for the speed and dexterity required to catch insects on the wing. The Bee-eater's bill has lengthened to let it catch the more dangerous insects; its central tail feathers have proportionately lengthened to restore the balance of flight.

In this specialisation of the Bee-eaters we see a good example of the important fact that variation is a means by which Nature minimises the competition amongst birds. The Bee-eater is able to use a source of food unavailable to other insectivorous birds in the same locality.

A rarer method of attaining breadth of bill without weight is to broaden the tip of the beak and leave the base normal; but this can only be done where the food is of a minute character and the breadth of beak is required to attain quantity rather than size. The most familiar example of this type of beak is found in the Spoonbill (*Platalea leucorodia*), and we find it again in that rare Plover (*Eurynorhynchus pygmœus*) which has a place in the Indian list. In the Spoonbill this beak is associated with a very curious feeding action; the bird wades quickly through the water with its neck stretched out and the beak half immersed, turning from side to side with a regular sweeping action like a man scything grass, so that the beak is passed sideways through the water. There is nothing on record about the use of the beak in the Plover.

Actual comparative breadth of bill is rare amongst birds. Under this head I should include forms like the Whale-billed Stork (*Balœniceps rex*), but there is no really outstanding Indian example, though the Broadbills (*Eurylaimi*) approach to it.

Finally the effect of breadth may be attained by elasticity.

The Pelicans (*Pelecanus*) and the Cormorants (*Phalacrocorax*), for instance, possess bills which cannot be considered as unduly wide in proportion to the size of their owners. Yet there is such elasticity in the bones of their lower mandibles and in their gular pouches that they are able to swallow fishes out of all proportion to the apparent size of their bills and gullets, while the lower mandibles and gular skin of the Pelican stretch into a regular fishing net.

Space will only permit of my describing two more specialisations in detail, namely those of the Crossbill and the Scissor-bill.

The Crossbill (*Loxia curvirostra*) is a widely spread finch which is represented in the pine forests of the Himalayas by a local race (*L. c. himalayana*). This bird may be described as parasitic on various species of conifer on the seeds of which it feeds, and its movements are in consequence irregular beyond the movements of most birds, depending on the seeding of the forest trees over immense areas. As a substitute the pips of apples are also eaten.

To extract the seeds from their cones the Crossbill's beak has become so specialised that the bird cannot normally exist where this food is not obtainable. As indicated by the name the tips of the two mandibles cross each other, and thus are widely separated when the beak is closed. The upper mandible crosses to the right or left of the lower mandible in different individuals. (Plate F, fig. 13). The action and use of this curious modification was first fully studied and described by Yarrell with a wealth of anatomical detail. I may quote Professor Newton's less technical summary of the process: 'In the Crossbills the articulation of the mandible to the quadrate bone is such as to allow of a very considerable amount of lateral play, and by a particular arrangement of the muscles which move the former, it comes to pass that as soon as the bird opens its mouth the point of the mandible is brought immediately opposite to that of the maxilla (which itself is moveable vertically) instead of crossing or overlapping it—the usual position when the mouth is closed. The two points thus meeting, the bill is inserted between the scales or into the cone, but on opening the mouth still more widely, the lateral motion of the mandible is once more brought to bear with great force to wrench aside the portion of the fruit attacked, and then the action of the tongue completes the operation, which is so rapidly performed as to defy scrutiny, except on very close inspection.' The tip of the tongue ends in a horny scoop and while the two mandibles hold the scales of the cone apart the spoon-like tip of the tongue is inserted under the seed and loosens it to drop into the mouth.

The Crossbill is a most wonderful climber and uses its bill for climbing just like a parrot, so that it is able to attack the cones in any position on a bough. I have always seen them thus feeding on the cone still attached to the tree, but it is said also to cut cones off and hold them with one foot supported against its perch, in a manner which I have already noted as rare amongst birds.

The nesting Crossbill has a perfectly normal finch-bill and the peculiar curvature of the tips of the mandibles only commences about the time of fledging.

There is a pleasing mediæval German legend which attributes the bird's beak to its efforts to pull the nails from the Cross at the Crucifixion, while its colour is due to the blood that then stained its plumage.

The Scissor-bill (*Rhynchops albicollis*), is an aberrant Tern. It breeds with the Terns on the sandbanks of the larger Indian rivers; its eggs are similar to theirs. In plumage it greatly resembles them, and its young are similar to those of typical Terns. Yet in the adult there is one of the most curious specialisations of the beak found in the whole of the order Aves; and this is correlated with a peculiar and unique method of feeding, which has in turn affected the bird's flight and wings. The wings of the Scissor-bill have lost the perfect proportions of those of the true Terns and the flight is heavy and laboured in contrast to the dainty evolutions and swiftness of speed which have gained for the family the popular name of Sea Swallows.

Both mandibles are deep and greatly compressed from the gape forwards to the thickness almost of two knife blades; the maxilla or upper mandible is shorter than the lower and is capable of much vertical movement.

The reason for the shape of this curious organ is soon apparent as one cannot watch a party of Skimmers (as they are also called) on the wing for long without seeing it in use. Singly or in parties of ten to twenty birds they fly slowly backwards and forwards along the surface of the water, as if they were ploughing it, the elongated portion of the lower mandible cutting through the water with scarcely a ripple to mark its progress, so thin is the knife-blade.

The older writers speculated a good deal on the meaning of this action, and with their frequent bias to theory as opposed to observation even in one instance decided that the bird found a mere fascination in disturbing the placid surface of the water. But the bird is catching fish. It skims with the beak wide open in shallow water, the lower mandible cutting the water, the upper clear of its surface; a small fish strikes the razor edge and runs up the incline and the jaws close swiftly on it, holding it firmly in three cutting edges; for an examination of the beak shows that the two mandibles close together in the same fashion as a curling iron. The fish is then swallowed head foremost and if the bird's gizzard is opened the fishes will be found all packed neatly within, lying parallel like sardines in a tin. The fish thus captured are all of course of small size.

It remains to sum up the result of our study of the bird's beak, and I think it will be found that certain points emerge which hold good not only in respect to the structure of the beak but as general natural laws.

The structure of the beak, whether in shape or size or unusualness of feature is usually closely correlated with the food of the species. It is not therefore a very good guide to relationship or classification. For, when we find two species with very similar beaks it may mean nothing more than that their beaks are similar as the result not of relationship but of 'convergence'. That is to say the similarity of beak may have been attained through similarity of food; or the actual foods may be entirely different but a similarity of needs in dealing with it may have produced superficially the same structure.

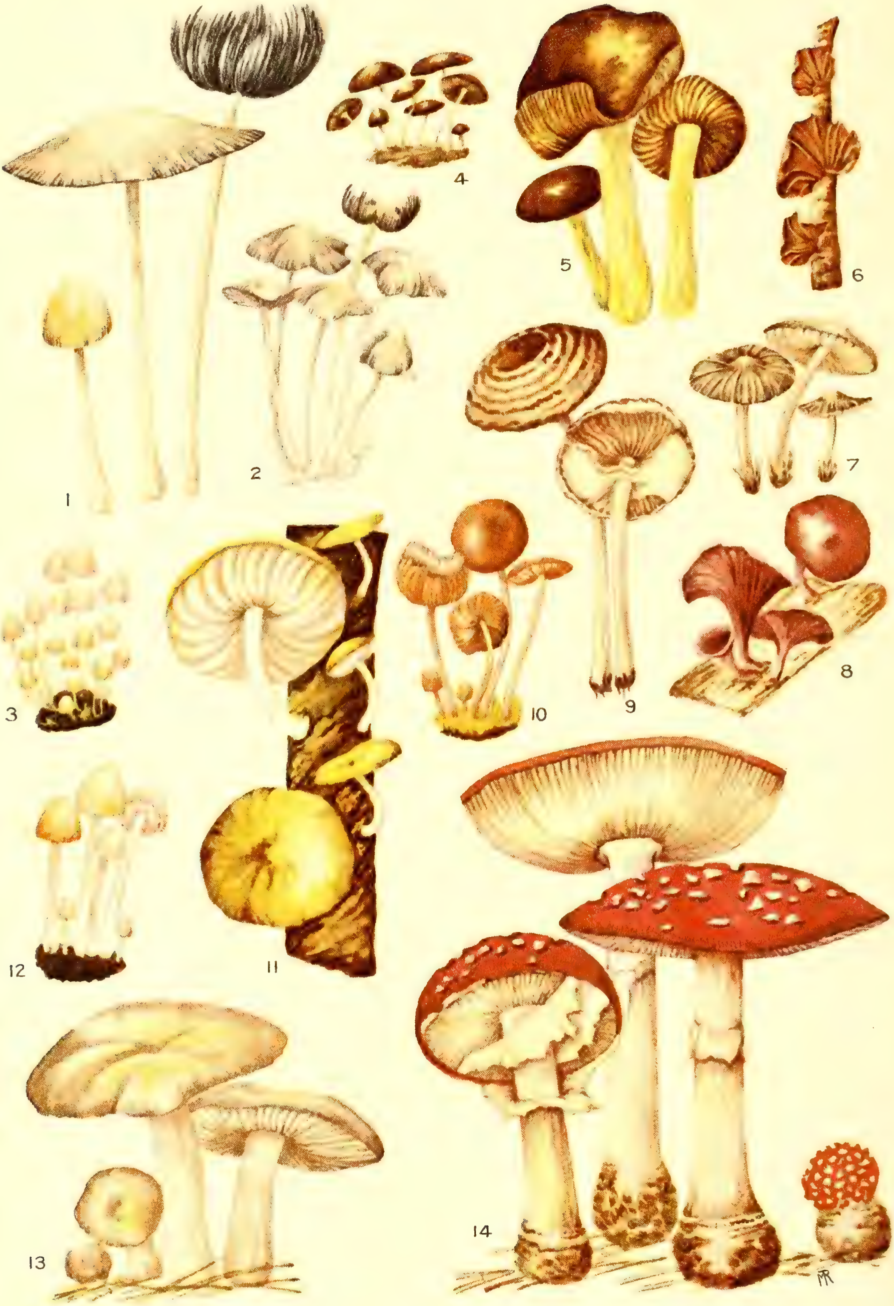
On the other hand closely related species may have developed very different beaks. This may be due to the very different foods available in the different areas that they inhabit; or it may be due to the need of eliminating competition in one area which they share as a habitat.

Adaptations may reach a very high degree of specialisation, in which case they postulate the presence of a special diet or manner of obtaining it. The species that attain to them are usually not to be considered as very vigorous or likely to survive in the struggle for existence. For the attainment of high specialisation may mean a shirking of competition for the ordinary standard foods, and its presence might mean extinction if the special source of food were to fail from any cause.

The most highly specialised forms of beak appear at a comparatively late stage in the development of an individual, an indication of their recent development in the species and an additional reminder of the fact that the superficial structure of a beak is of little value in classification.

Finally the structure of the beak needs to be considered in close relationship with that of the tongue, and it may also need to be accompanied with special modifications in the digestive apparatus.

(*To be continued*)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SOME TYPES OF AGARICS OR GILL-BEARING FUNGI.

FLOWERLESS PLANTS

BY

M. Robinson, B.A. (T.C.D.), NAT. SCI. TRIP. CAM.

Part II

The Fungi

(*With one coloured and five black and white plates*)

(*Continued from page 575 of this volume*)

The Fungi are probably the widest known of the Cryptogamic plants, and have always attracted popular attention and appealed to the popular imagination. The old names given to many of them, such as toadstool, mushroom, puff-ball, ink-cap, lawyer's wig, horn-of-plenty, fairy club, stink-horn and dry to rot, to mention only a few, bear witness to the fact that they must have been familiar to the old country folk, and were known in the same way as were the wild flowers of the fields and hedgerows, which often have such delightfully descriptive names.

Their wide range of habitat, and almost universal distribution render them familiar objects everywhere; and it is an interesting fact that the same species are found in many different parts of the world, occurring in all kinds of different localities; the common English mushroom (*Agaricus campestris*) for instance, has been found in India at sea level, where the mean annual temperature is 83° and also at an altitude of 7,000 feet and over, with a mean annual temperature of 57°. Several other species also found in England have been found in these places, as well as in other distant parts of the world, such as Australia and America.

There is one characteristic which is common to all fungi, and which distinguishes this group from all other groups of plants. No fungus plant ever contains any chlorophyll, the green colouring matter found throughout the plant world. The importance and use of chlorophyll to a plant was described in a previous article, and lies in the fact that in its presence, the plant can obtain carbon dioxide from the air, and under the influence of sunlight, can manufacture it into other substances necessary to the growth of the plant. In the absence of chlorophyll, this photosynthetic process cannot take place, and plants that lack it, like the fungi, must therefore obtain their carbon material from other sources; either from other living plants, which already contain it, or from dead or decaying plant or animal matter. Those that choose living plants are known as *parasites*; while those that prefer dead and decaying organic matter are known as *saprophytes*.

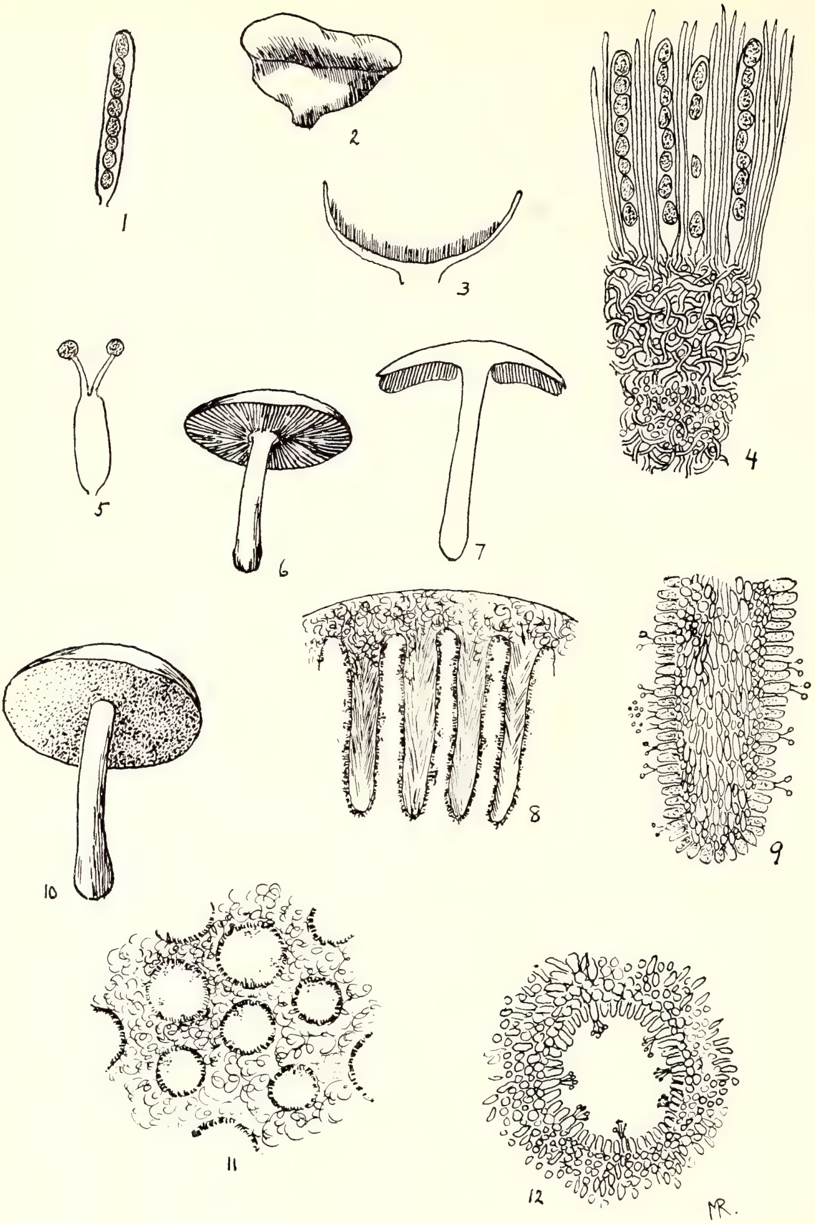
All fungi therefore are either parasitic or saprophytic, and will be found growing upon living trees, roots, trunks and branches; on leaves; and on the flowers and stems of many grasses and grains. They generally cause the death of the host plant, and it is no uncommon sight to see giants of the forest slowly dying from the effects of the fungus that infests them, their leaves becoming patched and mottled, shrivelled and discoloured; while whole fields of wheat, rye, barley and other cereals are ruined, and vast crops destroyed by the attacks of the deadly smut, ergot or rust fungi. Species of pine and fir are particularly liable to be attacked, and enormous annual losses among the pine forests of America and Germany have been recorded.

The saprophytic fungi do almost as much harm, as they attack timber used for buildings and other similar purposes, and so thorough is their action that a large solid beam may be reduced in course of time, to a powdery mass, and become a positive source of danger. Others prefer leather and other manufactured goods, particularly in a damp climate; and all decaying fruit and vegetable matter instantly offer a home to the wandering spores of all the moulds and mildews.

Many of the fungi are edible and form delicious dishes when cooked; but on the other hand, many are poisonous and very unpleasant effects may be the result of sampling a species that is not known for certain to be harmless. The poisonous varieties so often resemble the edible ones, that it is sometimes difficult to tell the good from the bad. Poisonous kinds in the fields and open ground are often eaten by grazing cattle, causing illness and death and consequent loss to the farmer. A pamphlet published in 1926 by the British Ministry of Agriculture, at three shillings, entitled 'Edible and Poisonous Fungi', describes sixteen species of the former and nine species of the latter, and all are illustrated with coloured plates.

The economic importance of the fungi lies chiefly in the evil that they do, and there is still a vast field open to the investigator, in studying the life histories of the more minute kinds that produce so many of the deadly diseases of the higher plants. Their number is legion, and it is not with these that this paper will deal, but only with those that are usually called the 'larger fungi' those common and more familiar kinds that can be found everywhere, and that can be readily recognized and often identified without the use of a microscope.

The part of the plant usually called 'the fungus' is the sporophore, and generally bears thousands, often millions, of spores. When a spore germinates, it sends out a slender colourless thread known as a 'hypha'; these hyphæ branch and intertwine, and ultimately form a felt-like mass of anastomosing threads, which is known as the 'mycelium', and is really the thallus or body of the plant. The mycelium can often be seen on branches or twigs of trees, on dead leaves, or on any of the usual fungus habitats, as a soft white or greyish mass, woolly or silky in appearance: but more often it remains hidden below the bark or other surface, or beneath the ground, among rotting manure or humus, and it is only the sporo-



DEVELOPMENT OF SPORES IN ASCOMYCETES AND BASIDIOMYCETES.

1. An ascus containing 8 spores.
2. Fructification or cup of Peziza, an ascomycete.
3. Section through cup showing asci on inner surface.
4. Section through part of cup, asci and paraphyses, with tangled hyphæ below.
5. A basidium with two spores.
6. Fructification of a basidiomycete.
7. Section through same showing plates or gills which bear spores.
8. Tangential section through upper part of 6, showing gills bearing basidia and spores on edges.
9. Section through one gill showing centre part of tangled hyphæ, basidia and paraphyses on edges.
10. Fructification of a basidiomycete with holes or pores in under surface.
11. Section of under surface.
12. Section of one pore showing basidia lining inner walls.

Figs. 1, 4, 5, 9 and 12—very highly magnified. Figs. 3, 8 and 11—slightly magnified.
Figs. 2, 6 and 10—$\frac{3}{4}$ natural size.

phore that emerges and can be seen. The mycelium may often remain in this condition for a long time until favourable conditions arise for the production of sporophores, which arise on the mycelium as little swellings formed of masses of densely conglomerated hyphae ultimately developing into structures of a highly complex character. The structure of the sporophore differs very widely in different fungi, and the classification into divisions, families and genera is based on this. There are three main divisions, but we are only concerned with the one that contains the larger fungi and which is divided into two main orders, the *Ascomycetes* and the *Basidiomycetes.*

The *Ascomycetes.*—In the *Ascomycetes* the spores are enclosed in a sac-like spore case which is called an ascus. Each ascus contains either four or eight spores, and when highly magnified appears as shown (Pl. II, fig. 1.) The asci are grouped together with sterile hairs which are known as 'paraphyses' on the inner surface of a more or less open cup or disc-like fructification (Pl. II, fig. 2.) These little cups or discs are often brightly coloured and extremely pretty, and can usually be found on tree trunks, and twigs and branches in any wood or forest. A section through one of the cups of the genus Peziza is shown (Pl. II, figs. 3 and 4.) In another group, the *Tuberaceæ,* the asci are completely enclosed in more or less spherical or tuber-like fructifications which are always subterranean. These are the famous edible truffles chiefly found in the South of France and the West of England.

The *Basidiomycetes.*—In this order the spores are not enclosed in a spore case, but are borne free, two or four together on the end of a club-shaped structure known as a 'basidium'. A very highly magnified basidium bearing spores is shown. (Pl. II, fig. 5.) There are two divisions of the *Basidiomycetes,* the *Gasteromycetes* and the *Hymenomycetes.*

In the *Gasteromycetes* the basidia are borne inside a closed fructification which bursts or splits or simply rots away liberating a cloud of spores when ripe. In this sub-order are the puff-balls, earth balls and a few other genera. (Plate III). In the *Hymenomycetes* the basidia are not enclosed but are freely exposed to the air, and are borne on a special layer known as the 'hymenium' or hymenial layer, which may spread all over the sporophore; or may be confined to certain portions such as the underside of the cap of a mushroom or the inside of numerous small holes or pores where it gets a certain amount of protection. (Plate II, figs. 5-12.)

The *Basidiomycetes* contain by far the largest number of species, and include all the larger and better known fungi, so we will take the two sub-orders in a little more detail.

The *Gasteromycetes.*—The fungi in this sub-order produce their spores on basidia, in a more or less spherical or nodular structure, which is covered with a rather thick outer skin called the 'peridium'. The peridium only ruptures or decays to liberate the spores when they are quite ripe. There are five families or natural orders included in the *Gasteromycetes.*

1. The *Hymenogastraceæ* or False Truffles.—These resemble the true Truffles, which belong to the Ascomycetes, in being

subterranean, nodular structures, dark brown or reddish in colour, and in being edible. They were formerly very plentiful in the West of England and were often found in the shops of Bath and other market towns under the name of 'red truffles'.

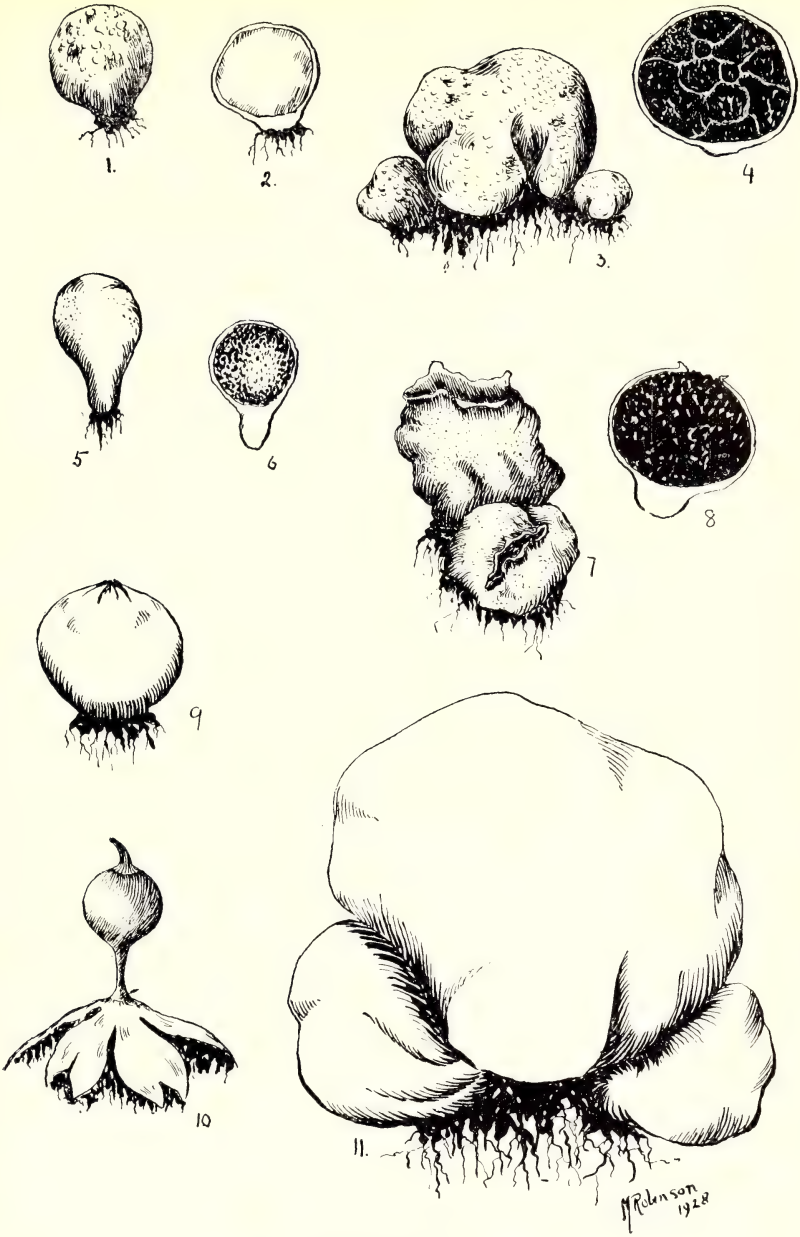
2. The *Nidulariaceæ* or Birds' Nest Fungi.—These are dainty little fungi which can be found growing on dead twigs and among dead leaves at the base of forest and jungle trees. They are at first little ovoid or spherical structures about a quarter of an inch in diameter only, and with a rough slightly spiky outer surface. They open at the top forming a little cup, at the bottom of which are seen several small spherical bodies, each of which contains spores. The whole structure looks exactly like a tiny nest with eggs in it.

3. The *Sclerodermaceæ* or Earth-balls.—The fungi in this order very much resemble the Puff balls of the next order, but are usually darker in colour and generally have a rough and warty outer surface. Some of them contain a substance which gives a yellow dye when dissolved in water, and are still used in the South of France for the dye. The spore mass does not split up and become powdery when ripe.

4. The *Lycoperdaceæ* including the Puff-balls and Earth-stars (Plate III, figs. 1-9).—This order includes the familiar Puff-balls which are distinguished from the Earth-balls by the fact that when ripe the spores form a greyish or greenish powdery mass. The peridium is generally smooth and shiny and a light cream colour, resembling white kid, and some of the fructifications grow to an enormous size. The big white giant puff ball may be found of any size up to twelve inches in diameter but much larger specimens have been recorded. When young the whole of the inside is a soft white spongy mass, and if gathered in this condition, cut in slices and fried, it is said to be delicious to eat.

The Earth-stars resemble the Puff-balls in their early stages, but here the peridium consists of two or three layers. The outer layer splits into five or six regular segments, and turns backwards, and remains spread out on the earth like a star. At the centre of the star is a little globular body usually of a delicate slate grey colour, sometimes sessile but sometimes borne aloft on a little slender stalk. The top is peaked and marked with curved striations, as though one had twisted it. This curious and beautiful little fungus is illustrated in Pl. III, figs. 10 and 11. Another species found in pine woods was much larger, being about five inches across when expanded, and having thick fleshy segments of a deep orange yellow, while the centre was dark reddish brown, so that the whole thing rather resembled a sun-flower lying on the ground.

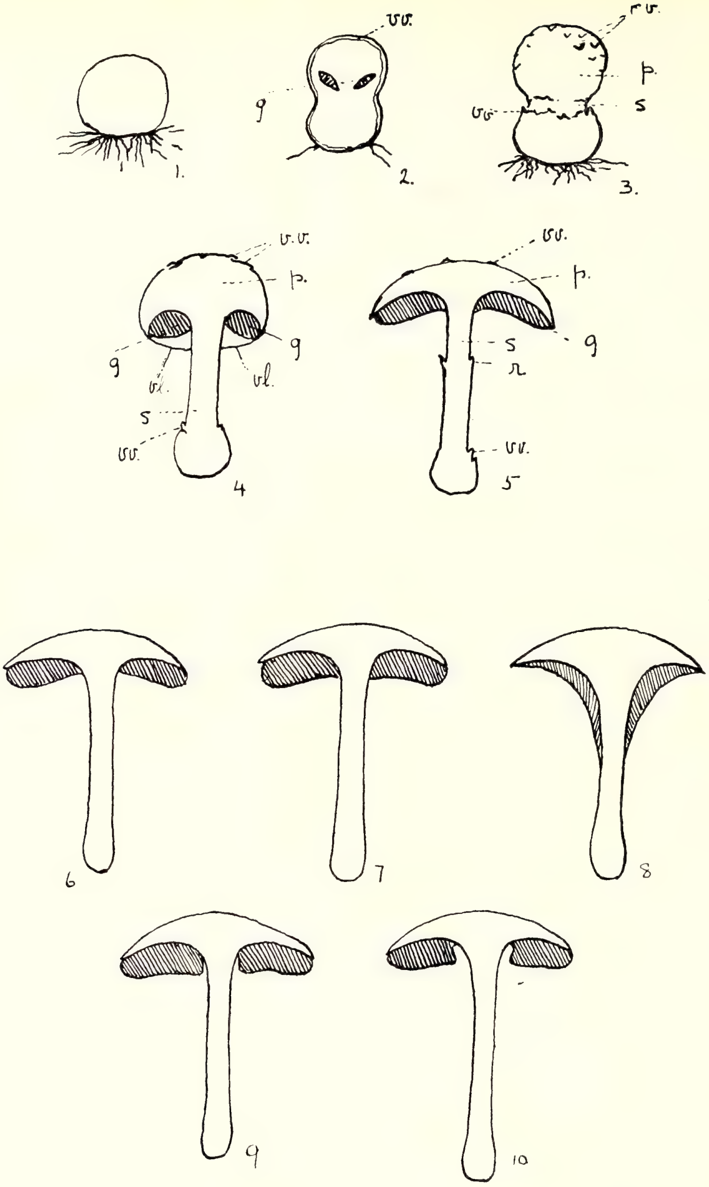
5. The *Phalloideæ* or Stink-horn Fungi.—These fungi as their name implies are characterized by a highly foetid odour when ripe. The sporophore when young is ovoid and covered with a whitish peridium the whole resembling an egg partially buried in the ground. When ripe the peridium ruptures and the spore mass which is enveloped in a glutinous evil smelling substance is borne up on a long stalk, which grows with great rapidity, as much as four inches in an hour and a half having been observed.



SOME TYPES OF GASTEROMYCETES.

1. A young puff ball.
2. Section through same—spore walls pure white.
3. Older stage of same—outer skin rots away.
4. Section through older stage—spore mass deep purple.
5. A young puff ball—another species.
6. Section through same.
7. Older stage of same—outer skin splits at definite opening.
8. Section through same—spore mass dark olive brown.
9. Young stage of Geaster or Earth star.
10. Later stage of same—outer peridium split and turned back forming a star.
11. Giant puff ball.

Figs. 1-10—¾ natural size. Fig. 11—⅜ natural size.



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DEVELOPMENT OF SPOROPHORE OF AN AGARIC, AND SECTIONS SHOWING METHOD OF INSERTION OF GILLS.

1. Young fructification.
2. Section through same—showing volva (vv.) intact and rudimentary gills (g.).
3. Later stage—volva just ruptured—showing differentiation of pileus (p.) and stem (s.).
4. Section through slightly later stage—showing gills (g.) still covered by veil (vl.).
5. Section through mature sporophore (p.) expanded, vl. has ruptured, exposing gills and forming ring (r.) on the stem.
6. Gills, adnexed.
7. Gills, adnate.
8. Gills, decurrent,
9. Gills, free.
10. Gills, remote.

The Hymenomycetes.—In this sub-order, the basidia are borne on a special surface known as the hymenium which is not enclosed in an outer covering, except in a very young stage of the sporophore, but is freely exposed to the air before the spores are ripe. The hymenium may spread over the whole surface of the sporophore, or it may be confined to the under surface, where it covers projecting teeth, or lines the inside of small holes or pores (Pl. II, figs. 10-12) or edges both sides of a folded plate or gill (Pl. II, figs. 6-9). A number of natural orders are distinguished by the manner in which the hymenium is borne. The sporophore itself shows great variety of structure; the simplest form, which is usually found in the pore-bearing, or teeth-bearing fungi being merely a thickened hymenium layer spreading over the surface of the host plant. This form of sporophore is said to be 'resupinate' (Pl. V, figs. 3, 4 and 8) and usually occurs on horizontal logs and tree trunks. In some species of the polypores, if the log is in a vertical position, it is found that the resupinate layer often becomes much thickened at the edges, or at one edge, and forms a projecting portion which is plain and sterile on the upper surface—having the hymenial layer on the under side (Pl. V, fig. 8). This is the simplest form of the bracket or shelf-like form of sporophore, which is so common on tree trunks. Sometimes hundreds of them, one above the other, run up the side of a tree trunk, thin and delicately coloured like little fans (Pl. V, figs. 9 and 10); or one or two huge, thickened, weird looking structures may be found at the base of an old tree trunk, resembling nothing so much as a large misshapen hoof (Pl. VI, fig. 5). The highest development of the sporophore is seen in the familiar mushroom or toadstool form—where the hymenial layer is borne on the under side of the cap or 'pileus' which is borne aloft on the stem or 'stipe' (Pl. I and Pl. II, figs. 6 and 10). When very young the sporophore is globular or egg shaped, and entirely covered by an outer protecting skin known as the volva (Pl. IV, figs. 1 and 2). This very soon ruptures, and fragments of the lower part remain at the base of the stem, often forming a kind of cup (Pl. IV, figs. 3-5, and Pl. I, figs. 7 and 14) while fragments of the upper part are often carried up on the top of the pileus where they form white or cream or brown flecks or scales (Pl. I, figs. 7, 9 and 14). A further protection for the hymenial layer is sometimes found in the form of a thin membrane called the 'veil', which stretches from the edge of the pileus to the stem (Pl. IV, No. 4), covering the gills till the spores are nearly ripe, when it ruptures as the pileus expands and fragments remain forming a 'ring' on the stem (Pl. IV, No. 5, Pl. I, Nos. 9 and 14). Amanita (Pl. I, No. 14) has a double veil, which leaves an upper and a lower ring on the stem. The ring is often evanescent and not found in old specimens.

The Hymenomycetes are subdivided into natural orders according to the manner in which the hymenium layer is borne on the sporophore. There are six of these natural orders and specimens of most of them can be found in almost any locality.

1. The *Tremellinaceæ* or Gelatinous Fungi.—These are fungi of a gelatinous consistency when moist, becoming thin and papery or

horny when dry: and of a yellow or brownish colour, drying to grey or brown. They are usually fan-shaped or bracket-shaped and wrinkled, but may be club or cup-shaped, and are practically all found on tree trunks or branches either living or dead.

2. The *Clayariaeæ* (*clava,* a club) also called Fairy Clubs.—These are dainty little plants usually not more than one or two inches high, and most descriptively named. The hymenium is spread over the surface of the clubs which are white, yellow or brown. They are found on wood, or among the grass in the ground. One resembles a miniature bulrush (Pl. V, figs. 1 and 2).

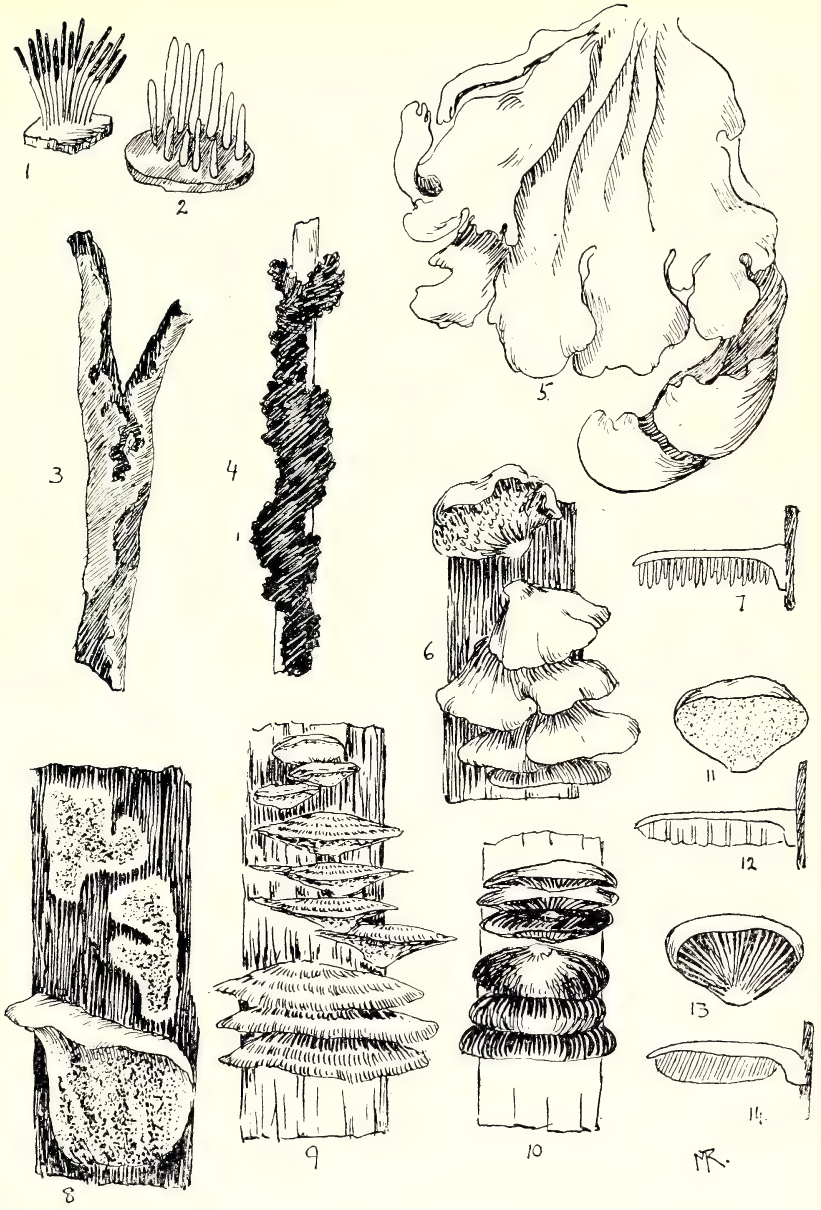
3. The *Telephoraceæ* or Leathery Fungi.—The sporophore here is flat and spreads over the surface of the host, like a thin plate (Pl. V, figs. 3 and 4) or is bracket-shaped (Pl. V, fig. 5) or cup-like. The well known 'horn-of-plenty' which is an edible species when young, has the hymenium spread over the outer wrinkled surface of the horn.

4. The *Hydnaceæ* or Teeth-bearing Fungi.—In these the hymenial layer is spread over spines or teeth which project from the under surface of the pileus (Pl. V, figs. 6 and 7) or merely from resupinate patches of irregular lumps or tubercles on the dead branches of the host. In colour they are dingy white, yellow, orange or brown.

5. The *Polyporaceæ* or Pore-bearing Fungi.—Here the hymenium lines the inside of numerous pores or tubes, on the under surface of a pileus (Pl. V, fig. 9 and Pl. VI) or merely spread out in resupinate patches on the host (Pl. V, fig. 8). The pores can generally be seen with the naked eye, but are sometimes too small to be distinguished without the aid of a lens. The hymenial layer often differs in colour from the rest of the sporophore—as in species of *Fomes* (Pl. VI, fig. 7) where the pileus is a bright, foxy red, while the underside is white. Many beautiful colours red, purple, orange and yellow are found among the polypores, especially in the genus *Boletus* (Pl. II, fig. 10), which has the mushroom-like sporophore, and grows in the ground chiefly under pine, fir, and larch trees. It is also edible and much liked in Italy. A few other common polypores are shown in Pl. VI.

6. *Agaricaceæ,* the *Agarics* or Gill-bearing Fungi.—This is the largest order of all, and contains an immense number of species. A number are illustrated in Plate I, all found in South India, some at sea-level (Figs. 1, 2, 4 and 7), the rest in the Hills at an altitude of 7,000 feet and over.

The Agarics are usually classified according to the colour of the spores, into *Melanosporæ, Porphyrosporæ, Rhodosporæ, Ochreosporæ* and *Leucosporæ,* indicating black, purple, red or pink, yellow and white spores respectively. The colour of the gills when mature usually indicates the colour of the spores, but when young the gills are often of a paler, sometimes different, colour—white becoming rust red or black as in *Volvaria* and *Coprinus*; pale pink changing to deep purple brown, as in the common mushroom, *Agaricus arvensis.* The shape and insertion of the gills varies in different genera. Sometimes they run right into the stem, but do not touch it for the whole of their depth (Pl. V, fig. 6); they are then known as 'adnexed'. 'Adnate' gills touch for the



SOME TYPES OF THE HYMENOMYCETES.

1, 2. Two species of the Clavariacæ or Fairy clubs.

3, 4, 5. Three species of the Telephoraceæ or leathery Fungi. No. 3 is a deep salmon pink with a white edge, and No. 4 is black with a frilled edge, both encrusting small twigs.

6, 7. Hydnum Ochreum, one of the teeth bearing fungi. No. 7 is a section through the pileus.

8. A resupinate polypore, which in the lowest figure is developing a horizontal pileus.

9. Polystictus Abietinus, pale mauve bracket-like pilei.

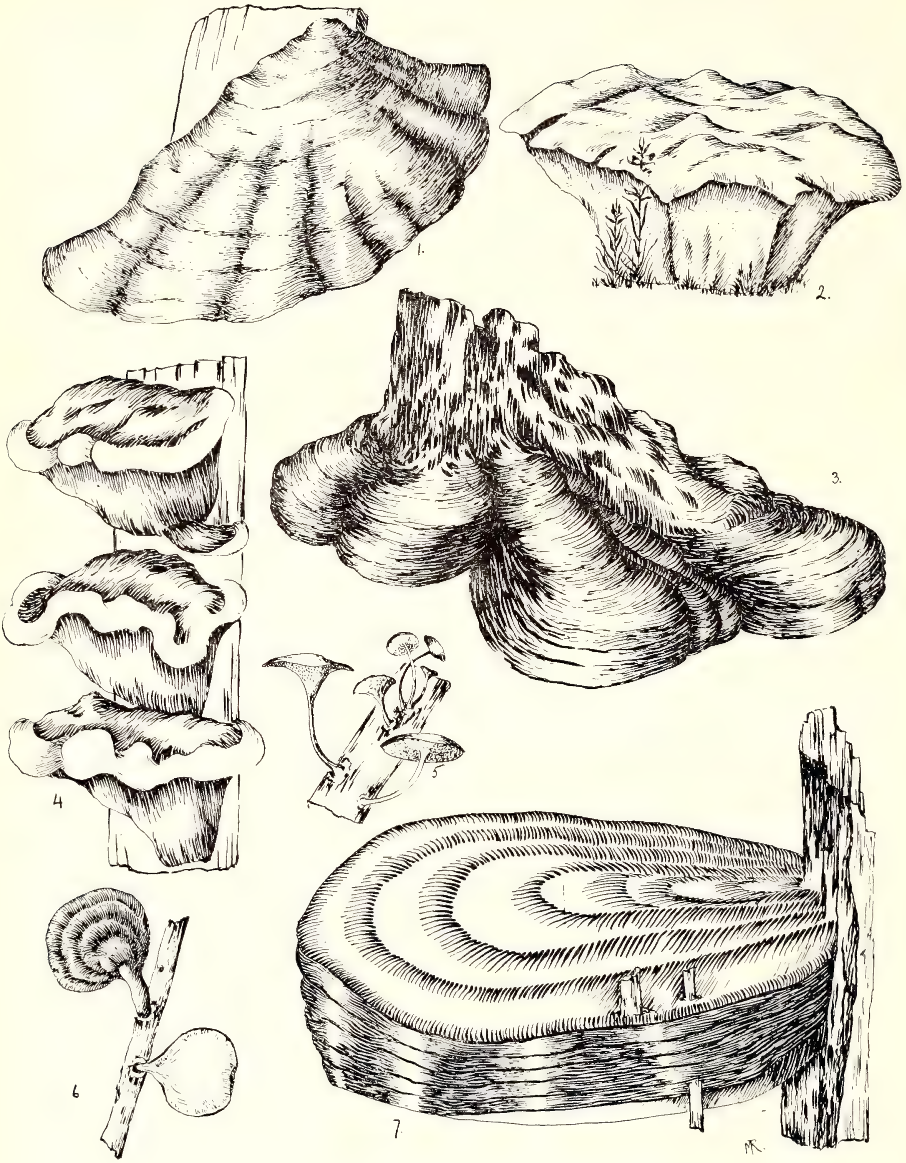
10. Anagaric with bracket-like pilei of velvety grey.

11. Under side of 9.

12. Section through a pileus of 9.

13. Under side of 10.

14. Section through a pileus of 10.



SOME COMMON POLYPORES.

1. Dædalea Unicolor—rather leathery grey.
2. A soft white fleshy species growing in the ground.
3. Fomes pitchii—very hard and woody, quite black.
4. A hard woody species—upper surface bright, chestnut brown, lower surface white.
5. Polyporus agaricans.
6. Polystictus flabelliformis.
7. Fomes Applanatum—bright foxy red, with white under surface.

Fig. 1-6—reduced to $\frac{1}{5}$ natural size. Fig. 7—reduced to $\frac{1}{10}$ natural size.

whole of their depth (Plate V, fig. 7). When they run down the stem as in fig. 8 they are called 'decurrent', while fig. 8 shows them 'free' from the stem, and in fig. 9 they are 'remote' and joined at a 'collar' well away from the stem.

When collecting Agarics some of the spores should be taken for examination and identification, and the best way to do this is to make a spore 'print'. The stem is cut off close to the gills, and a large pin pushed through the centre of the pileus, to protrude through the cut stem, and then stuck into a piece of absorbent paper on a board. If left in a sheltered place for an hour or two, the spores will fall on to the paper, and when the pileus is lifted carefully away, a complete 'print' formed by radiating lines of spores will be found on the paper. A dark paper should be used for white spores. In order to keep the print, it should be fixed in the same way as a pastel or chalk drawing is fixed. The medium sold for this purpose is quite successful or a weak solution of gum arabic may also be used. For white spores a solution of 1 part of gelatine in 30 parts of water is recommended. The print should be laid on a flat dish or plate, and allowed to soak up the fixative from below, as the spores are very easily displaced.

For those interested in the study and collection of Fungi, a most useful little book to have is '*Fungi and How to Know Them,*' by E. W. Swanton (Methuen). This has numerous excellent coloured plates and is full of interesting and useful information and is quite inexpensive. There is no book on Indian Fungi yet published, and it is difficult to identify the various species. The writer would like to acknowledge here, with grateful thanks, the help received from Professor S. R. Bose, of the Carmichael Medical College, Calcutta, in identifying many species, chiefly of the Polypores.

Explanation of Plate I (*Coloured*)

1 and 2. Species of *Coprinus* (*Melanosporeæ*).
3. *Psathyrella disseminata* (*Melanosporeæ*).
4, 5 and 6. Species of the *Ochreosporeæ*.
7. A species of the *Rhodosporeæ*.
9. A species of the *Porphyrosporæ*.
8, 10, 11, 12, 13 and 14. Species of the *Leucosporeæ*.
(1 to 13 reduced to ½ and 14 reduced to ¼ size).

(*To be continued*)

NOTES ON THE BIRDS OF THE UPPER BURMA HILLS

PART I

BY

P. F. WICKHAM

(*With a map and 3 plates*)

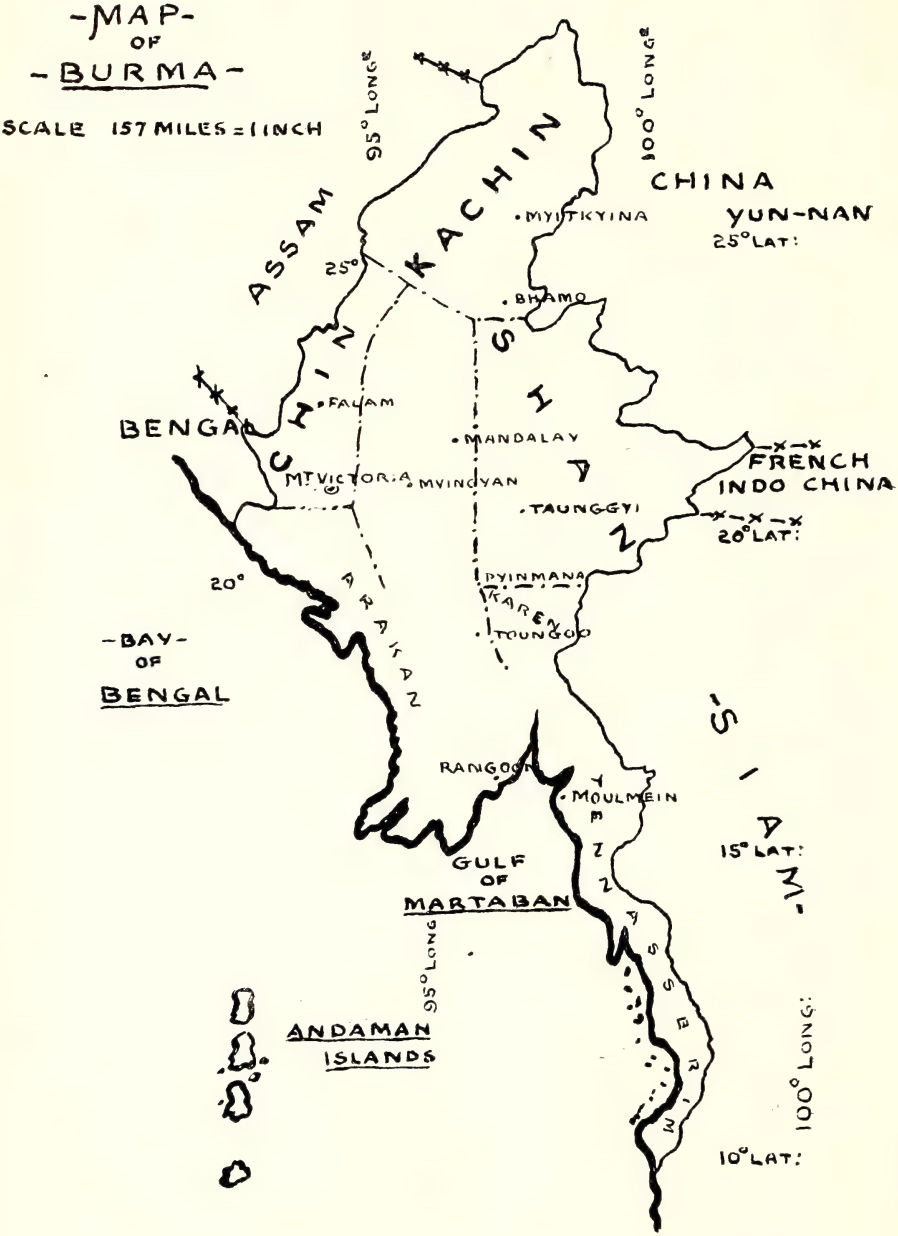
> '*Hast thou learnt all the birds without a gun*
> *Loved the wood rose and left her on her stalk?*'
>
> Emerson.

Reminiscences are always delightful to oneself, and this must be partly my excuse for presuming to write these notes so soon after the Second Edition of the Fauna of British India '*Birds*' by Mr. E. C. Stuart Baker has been published.

The ordinary ornithological enthusiast, generally termed a Field Naturalist, in reading this Second Edition is rather overcome, I speak for myself anyway, by a sense of confusion in elaborated nomenclature and description; the old favourites have in many instances lost their familiar scientific names and to differentiate them from their relations in other parts have generally now a third name added. The reduction in the number of species is very welcome and no doubt the inauguration of subspecies has been inevitable, but I believe the ordinary 'Field naturalist' would have preferred that a description of any species with a note of geographical variation might have sufficed, such a variation being named or not. However, trinomial nomenclature has come to stay and must be accepted—Geographical distribution and general features of the different parts of the Indian Empire require careful study as they now play such an important part in such nomenclature—Mr. Stuart Baker's note 'Subspecies and the Field Naturalist' (vol. xxvi, p. 523,) of this *Journal* is more than sufficient to lead one to accept the necessity for trinomial nomenclature. No field naturalist can fail to enjoy the description of the birds he knows, as given in this last edition of the *Fauna*, and it is difficult to add to them.

The liberty has however been taken in these notes to correct any mistakes in the names of places (distribution) mentioned in the new edition of the *Fauna* which seem apparent.

Burma is the largest province of the Indian Empire and seems to be a buffer area for the birds of India (proper) and China; the country is not well known, at any rate to most of the members of this society, and therefore further notes may be of interest, especially if one is able therein to help members visualize the features of the country of Burma.


-MAP-
OF
-BURMA-
SCALE 157 MILES = 1 INCH
95° LONG
100° LONG
CHINA
YUN-NAN
25° LAT:
KACHIN
MYITKYINA
ASSAM
25°
BHAMO
CHIN
FALAM
SHAN
BENGAL
MANDALAY
FRENCH INDO CHINA
MT VICTORIA
MYINGYAN
TAUNGGYI
20° LAT:
20°
PYINMANA
KAREN
TOUNGOO
ARAKAN
-BAY- OF BENGAL
SIAM
RANGOON
MOULMEIN
15° LAT:
GULF OF MARTABAN
TENASSERIM
95° LONG
ANDAMAN ISLANDS
100° LONG:
10° LAT:

NOTES ON THE BIRDS OF THE UPPER BURMA HILLS.

Shortly after Mr. Oates wrote his 'Birds of Burma' in 1883, Upper Burma or, as he called it, Independent Burma, was annexed and with it those parts of Burma which come so frequently under notice by name in the *Fauna*, the Chin and Kachin Hills and the Shan States (also hills); I quote Mr. Oates' description of Burma as it was in 1883 and enlarge on it to describe Burma as it now is.

'British Burma is an irregular narrow maritime country, hardly any portion being more than 200 miles from the sea; it lies entirely within the tropics. It is bounded on the east by Independent Burma and Siam; the general character of the country may be said to be mountainous, the only flat portions being strips of land along the banks of the larger rivers and considerable areas at the mouths of these rivers.' Mr. Oates divided his British or, as we now call it, Lower Burma into three divisions, Arakan, Central and Tennasserim, and proceeded to describe their features. The Western Division, Arakan, he describes as 'mountainous throughout', and mentions the range of mountains separating Arakan from Upper, or as it was then, Independent Burma and Central Burma as being of considerable altitude and unexplored ornithologically then. The Central Division he describes as traversed by two great rivers. 'The Irrawaddy River, which passes through British Territory for 300 miles, is a noble stream seldom less than one mile broad' with a fertile Delta. The second river, to the east is the Sittang of less magnitude and the range of hills between these two rivers is said to reach an altitude at the highest point of 2,500 ft. Tennasserim, he describes as 'consisting of a mass of mountainous ranges'—its northern portion traversed by the Salween River, 'one of great size but useless for purposes of navigation by reason of its numerous rapids'. Two of the highest peaks in Tennasserim are named Mooleyit and Nwalabo about 7,000 ft. altitude. The description almost applies to his Independent Burma, or as we now know it, Upper Burma, the Arakan range of hills continue north as the Chin Hills and the Tennasserim ranges continue north through Karenni, as the Karen country is called, and the Shan Hills both joining up into the Kachin Hills, which cover the whole north part of Upper Burma. Thus arises the formation of the hill divisions of Upper Burma, summarized by Government as 'backward tracts', occupied by the Chin, Kachin and Shan; racial names which comprise many tribes speaking different languages and having totally different customs and habits. These areas, I should add, are large; the Shan hills alone cover an area of 40,000 square miles. My map is intended to emphasize the position of these three hill divisions, as it is on the birds inhabiting them only that these notes are written. Some Assamese species of birds find their way down south *via* the Chin hills, Arakan hills, and across to Tennasserim, or if they go west through the Kachin hills, they keep west into Yunnan. The Shan hills, except perhaps in the extreme north, seem to pick up birds spreading west from China which at any rate are generally of a different subspecific rank to the Assamese birds. How far this is due to the area of plain country lying in Central Burma between the Shan and Chin Hills being a 'dry zone' one cannot say, but the dry zone with its annual rainfall of barely

20 inches (it contains a solitary volcanic formed hill about 3,000 ft. high called Mt. Popa) cannot be very attractive to the birds of the Eastern and Western hills accustomed to jungle and a good rainfall. If the lower hills mentioned by Mr. Oates as forming a range separating the Irrawaddy and Sittang river valleys, continued north through the dry zone, we might have had a totally different distribution of Burma birds, and Mr. Stuart Baker perhaps spared the description of many subspecies. On the west of Upper Burma flows that large tributary of the Irrawaddy River, the River Chindwin which is the eastern border of the North Chin Hills. The upper waters of this river is in unexplored country and contains the mountain ' Sarramatti ' over 12,000 ft. in altitude. Ornithologically a great deal remains to be done in these hills as the distribution of subspecies seems to me to be confused. Unfortunately any keenness on the subject seems to be confined to Europeans and their work nowadays is more exacting but many will still, I hope, look to birds to furnish them with enjoyable and interesting relaxation and in time subspecific geographical boundaries, if possible, will become definite ; to such these notes may be of assistance as I have endeavoured to provide a list of birds available in these delightful hills.

Personally I have tried ' to learn about birds without a gun ' and regret having been of so little use in the scientific study of them, but they have given me endless enjoyment.

I.—Family CORVIDÆ

Burma, even in these northern hills, is only represented by two species of crow. One might have expected a raven or a carrion crow in the very north of the Kachin Hills which border on Tibet, but so far these birds have not been recorded therein.

1. The Jungle Crow. Corvus coronoides andamanensis.

' Andamanensis ' is our subspecies in all these hills and throughout Burma I have never shot it nor measured it and never looked to see if it had white bases to its feathers or not. My idea of the bird is that it is ubiquitous but perhaps less communistic than the House Crow, and every jungle village knows them—neither shy nor retiring—and if one camps in any out of the way spot or even halts for a rest and snack a jungle crow must needs inspect you. As a poacher of eggs and young of other birds he has no equal.

In the Shan Hills they roost together in selected trees or bamboo patches in some numbers, and can be seen homing as *Corvus splendens* does in the evenings, although never in such large numbers ; in fact they have much the same habits as the House Crow. In the Burmese hills the first fortnight in March will be found the best time for eggs, which vary even in the clutch in colour shape and size.

2. The House Crow. Corvus splendens insolens.

Is the Burmese hill subspecies but confines itself more to the large towns at low elevations, in fact has not much use for jungle villages and the higher elevations.

3. The Magpie. Pica pica serica.

As might be expected, the Chinese subspecies inhabits the Eastern hills of Burma. The species has not been recorded in the north west, i.e., the Chin Hills.

In the Shan Hills this bird comes almost as far West as it can without leaving the hills, and as Mr. Oates does not record it in his *Birds of British Burma* the southern boundary presumably is the Karen country. Resident and a very confiding bird, seeming to like the proximity of man—noisy, continually chattering in the breeding season ; the young apparently keep with their parents till the next breeding season comes round.

Early March for eggs, but like rooks in England it visits the old nest long before it commences to lay. Harington found koel's eggs in the nest of this magpie on more than one occasion, but it was in the Shan and Kachin Hills as recorded in vol. xix, *B.N.H.S. Journal*, page 108, and not in the Chin Hills as recorded in the *Fauna*.

4. Red-billed Blue Magpie. Urocissa melanocephala magnirostris.

The Burmese Red-Billed Blue Magpie is a familiar bird and occupies, according to my observations, both plains and hills alike all over Burma, but the subspecies *melanocephala* may take its place in the eastern part of the Shan Hills. I saw a solitary individual of this species capture and carry off in its bill a large lizard—The lizard was on a tree trunk and tried to dodge the magpie by running round it, but the quarry was well hunted and after repeated digs or pecks fell to the ground when it was seized by the scruff of the neck and carried off—I expect this magpie to be about as big a poacher as the Jungle Crow.

Eggs in my collection taken near Rangoon, Chin Hills and Shan Hills, vary as to size, shape and colour. Old birds get very excited and noisy when their nest is approached by man and 'give it away.' April appears to be the nesting month.

5. The Yellow-billed Blue Magpie. Urocissa flavirostris flavirostris.

So far this species is only recorded from the Chin Hills at about 7,000 ft. on the higher part of the main range north of Falam. I discovered the bird nesting at the end of April and shot one of the parent birds. It was kindly identified by Mr. Stuart Baker and, as now recorded in the *Fauna*, he stated it differed somewhat from the Indian bird. Sites of nests were lower down on the tree than those of the red-billed blue magpie generally are and the two clutches vary somewhat in colouration, one clutch being rather coarsely and the other very finely spotted, and also vary in size.

6. The Green Magpie. Cissa chinensis chinensis.

This bird is found in all these Burma hills, but one would say is rather sparingly distributed. They are shy birds and hence not often come across and difficult to study. April seems the breeding month and numerous nests were taken by Mackenzie in the N. Chin Hills. The bird defeated me in the Shan Hills, but Harington records a seven-egg clutch in the Kachin Hills.

7. The Tree-pie. Dendrocitta rufa sclateri and kinneari.

A species inhabiting all these Northern Burmese Hills, but the Chin and Kachin birds are separated subspecifically as above. This Tree-pie seems to be more of a plains bird than the next and does not usually extend higher up than the foot hills.

Mackenzie records the taking of a nest of this species at Maymyo in the Shan Hills about 3,500 ft. elevation in April, but otherwise my records show eggs taken in the plains only and although I often found nests of *Dendrocitta* round Maymyo I always attributed them, I daresay wrongly, to *D. sinensis*.

8. The Burmese Hill Tree-pie. Dendrocitta sinensis assimilis.

Distribution as for *rufa* above. This bird does not vary subspecifically in Burma, and Chin and Shan birds are similar. In the *Fauna* the western limit is given as the Pegu and Arakan Yomahs (Hills). The Pegu Yomahs lie in the centre of Burma and this is therefore, I think, somewhat misleading. A garden visitor with a familiar call, nesting often quite low down on tree stumps and bushes within easy reach, but always well away from houses, usually during the last fortnight in April.

9. The Hooded Racket-tailed Magpie. Crypsirhina cucullata.

Personally I have never seen this small Magpie in either the Shan or Chin Hills, but a nest was taken by Sir S. Robinson near Maymyo in the Shan Hills, the eggs being identified by Mr. Stuart Baker. In the *Fauna* the distribution is a little confused. Monywa on the Chindwin River might be taken as its northern extremity, the foot of Mt. Victoria as its western and Pynmana (not on the Chindwin River) as its southern ; practically the ' Dry Zone ' of Burma as described under ' habits '. Harington did not record it round Bhamo, Kachin Hills.

10. The Burmese Jay. Garrulus leucotis leucotis.

The bird is found in the Eastern hills—recorded in the Kachin Hills, China side, by Harington and again by him in the Shan Hills, in the *Journal* of the Society. It seems to be very like its English cousin in habits. Harington's record of this bird's nesting in a community must be unique, for although I have often found the nest I have never come across a similar 'jayery'. For his description see *Journ. Bomb. Nat. Hist. Soc.*, vol. xx, p. 1003. Breeding month is April. The most favoured site for the nest is, I think, undoubtedly the end of a big leafy branch of an oak tree generally high enough to necessitate a climb or a ' leg up '.

11. Sharpe's Jay. Garrulus leucotis oatesi.

In the Northern Chin Hills, Mackenzie records the above subspecies, but in the Southern Chin Hills, Mt. Victoria, skins sent home by me were identified as the next species.

The distribution of *oatesi*, as noted in the *Fauna*, is not very happy, as the Chindwin River is like the Irrawaddy River—east of the Chin and Lushai Hills—The Irrawaddy River is a long way to the east but it may be this bird's eastern boundary in the Kachin Hills.

It may be as well also to note that the description of the colouration of the head in the new edition of the *Fauna* appears quite different to the colouration given in the Appendix to vol. iv, of the old edition. In the latter, more over, its distribution includes North-Eastern Burma, but it is evident that by this only the Shan Hills is meant. The bird at Maymyo, Shan Hills, has been identified as *leucotis* and it seems to me fairly certain that the subspecies *oatesi* is one inhabiting the N.-W. Burmese Hills only.

12. Rippon's Jay. Garrulus bispecularis haringtoni.

The new edition of the *Fauna* gives the distribution of this bird as South Chin and Kachin Hills. I think the inclusion of the latter country must be wrong unless *G. leucotis leucotis* and *G. leucotis oatesi*, and *G. b. haringtoni* all meet there.

The British Museum identified birds I sent home from Mt. Victoria as *G. bispecularis* and Rippon has evidently sent other skins home.

Both *leucotis* and *bispecularis* seem to have exactly the same habits.

The subspecies *rufescens* may come through the north of the Kachin Hills from south of the Brahmapootra River to Yunnan.

II.—Family PARIDÆ

13. The Indian Grey Tit. Parus major cinereus.

This bird must be included in this list as it has been recorded near Bhamo Kachin Hills (Harington) and North Chin Hills (Mackenzie).

14. The Burmese Grey Tit. Parus major commixtus.

The commonest representative in the Eastern Hills of Burma, as far north as Bhamo. It was this subspecies that obliged me by nesting in boxes in my garden in Maymyo (Shan Hills), not *P. m. cinereus* as recorded in the *Fauna*. This tit nests about the middle of March generally very low down, often in the ground on a bank, under a stone perhaps or even in an old white ants' nest hole, but a pair nested in the eaves of my two storeyed house. They sit tight when once incubation is started.

15. The Green-backed Tit. Parus monticolus monticolus.

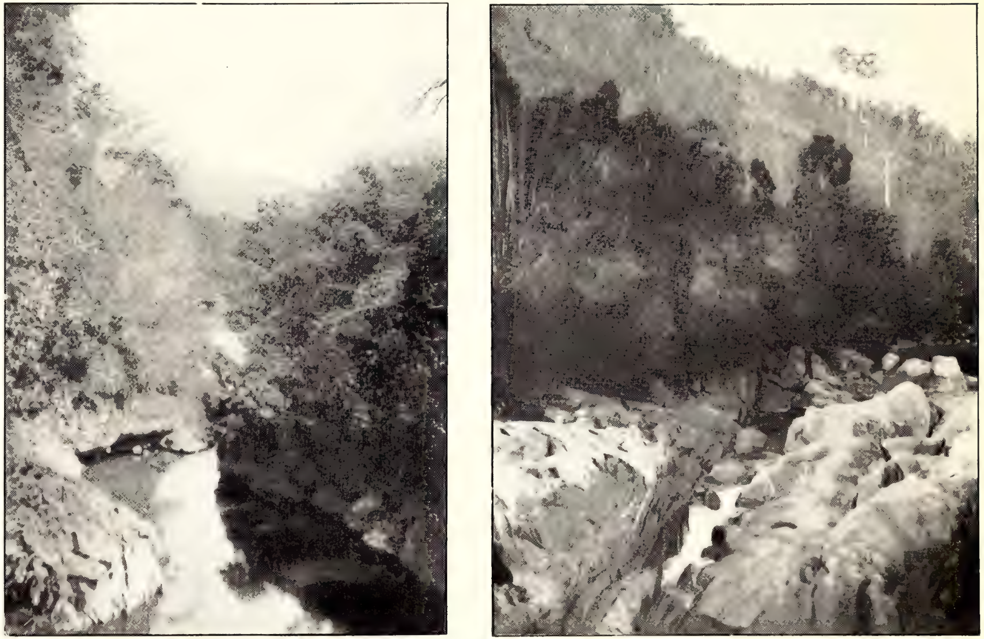
This subspecies inhabits the Western Burmese hills probably down to Mt. Victoria and Arakan hill tracts.

16. The Yunnan Marsh-Tit. Parus palustris pœcilopsis.

To correct the *Fauna*, Maymyo is in the Shan Hills, not Kachin Hills, but I cannot find the record and Maymyo should perhaps be read as Bhamo.

NOTES ON THE BIRDS OF THE UPPER BURMA HILLS.

The Taunggyi Crags. 5,600 feet.
Southern Shan States.



Typical Streams.

Shan States. Kachin Hills.

17. **The Yunnan Brown-crested Tit. Lophophanes dichrous wellsi.**

North Shan Hills.

I regret I have never noticed either the Marsh or Cole Tits in any of the Burma hills. They are evidently rare.

18. **The Chinese Yellow-browed Tit. Sylviparus modestus saturatior.**

Recorded from Mt. Victoria, Chin Hills, but it is also stated to be found in N. Burma and east into China—a record of a Chinese bird finding its way across to the western hills of Burma, but probably this bird has been overlooked.

19. **The Burmese Black-spotted Yellow Tit. Machlolophus spilonotus subviridis.**

I saw this bird in the Kentung State Shan Hills, which is the furthest eastern part of the Shan Hills. In April it was building, but some travellers passing disturbed it while I was watching, and the nesting material it was carrying was dropped, and the bird flew off.

Kachin Hills (Harington), N. Chin Hills (Mackenzie).

Mr. Oates in his *Birds of Burma* says, this subspecies is, according to Mr. Hume, only the young of *M. s. spilonotus*, but this is perhaps ancient history.

20. **Hume's Red-headed Tit. Ægithaliscus concinnus manipurensis.**

Each of our hills has its own subspecies of this bird. Mackenzie records it in the Chin Hills. (vol. xxv, p. 75).

21. **The Shan Red-headed Tit. Ægithaliscus concinnus pulchellus.**

South-eastern Hills.

22. **Rippon's Red-headed Tit. Ægithaliscus concinnus talifuensis.**

North-eastern Hills. Harington's description of the nesting of the latter bird is in (vol. xix, page 110) of the *Journal*. Kachin Hills not Shan Hills as recorded in the *Fauna*, to be exact.

23. **The Chinese Black-headed Tit. Ægithaliscus bonvaloti bonvaloti.**

Occurs in North-east Burma and the other subspecies *sharpei* the Mt. Victoria Black-headed Tit, in the higher mountains of the Chin Hills.

24. **The Indian Sultan Tit. Melanochlora sultanea sultanea.**

Occupies all our three hill divisions, I know the bird well in the Shan States, but cannot say I ever saw it in the Chin Hills. It has an unmistakable call as it forages in the high tree tops. I only once found the nest and that was destroyed before I calculated the time for robbing it had arrived. The nest was in a tree hole almost within reach of the hand, the tree being on the edge of a perennial stream (Elevation 3,000 ft.) and there was a dense lining of cotton down. I think the bird likes to be near water—April.

III.—Family PARADOXORNITHIDÆ

25. **Austen's Parrot-Bill. Paradoxornis guttaticollis.**

Kachin Hills (Harington), N. Chin Hills (Mackenzie).

26. **Salvadori's Suthora. Suthora poliotis feæ.**

This bird is apparently only known to occur at Fort Stedman, in the Shan Hills. Fort Stedman was a military Post and stands on the shores of Lake Inle just below Taunggyi. Elevation about 3,000 ft.

27. **Rippon's Suthora. Suthora poliotis ripponi.**

This subspecies occurs in the Chin and Kachin Hills.

28. **Bingham's Suthora. Suthora gularis craddocki.**

Recorded from the far east of the Shan Hills at high elevations.

29. **Anderson's Suthora. Suthora webbiana brunnea.**

Kachin Hills only (Harington).

30. The Black-browed Suthora. Suthora ruficeps atrosuperciliaris.
Kachin Hills (Col. Rippon).

31. Thompson's Suthora. Neosuthora davidiana thompsoni.
Southern Shan Hills.

32. Baker's Parrot-Bill. Psittiparus ruficeps bakeri.

The new edition of the *Fauna* gives all these hills as the habitat of these subspecies.

33. Hartert's Parrot-Bill. Psittiparus gularis transfluvialis.

Distribution as for the species *ruficeps*. I must confess I am myself very ignorant of this family of interesting birds. I have seen them very occasionally when I had not a gun and I once found a nest, without eggs, but could not visit it again. They seem rare and very local.

IV.—Family SITTIDÆ

34. The Chin Hills Nuthatch. Sitta victoriæ.

One of the numerous finds of Col. Rippon.

35. The Burmese Nuthatch. Sitta castaneiventris neglecta.

To be found in the Eastern Hills of Burma. The call is a familiar one and unmistakable. I found the species common to the Shan Hills. It is stated in the *Fauna*, quite correctly I think, to be an early breeder, but I was fortunate to get a clutch of fresh eggs on April 26th. 33 ft. up in a cotton tree. In taking the nest the climber had to come down before actually getting to the eggs and the two parent birds returned and began to pull out the cotton wool which had been stuffed into the hole to protect the eggs. The usual plastering had been done which had set very hard and the nest, if it can be called one, consisted of leaves with some thin flat tree seeds.

36. Austen's Nuthatch. Sitta europæa nagæensis.

Distribution Chin and Kachin Hills only.

37. The Giant Nuthatch. Sitta magna.

Shan States. Not recorded from the Chin Hills and Kachin Hills. I saw this bird on more than one occasion near Taunggyi, Shan States. Even in the compound of my bungalow, when I could watch it through glasses, it behaved more like an ordinary bird than a nuthatch and did not climb about the tree trunks. It seemed to be feeding on insects which were on the limbs of the trees and was active in its movements, and did not take long to examine the few trees in my compound. It made no call. Nidification is not recorded. I had hoped to find it in the rocky crags of Taunggyi Hill and searched for some signs, but I had no luck.

38. The Beautiful Nuthatch. Sitta formosa.

Shan States.

39. The Velvet-fronted Nuthatch. Sitta frontalis frontalis.

Apparently to be found in all these three parts of Burma. I have seen it in the Shan States at nearly 4,000 ft. I once saw a party of four or five, presumably a family party, but they did not give me much time to watch them.

V.—Family TIMALIDÆ

40. The Rufous-necked Laughing-Thrush. Dryonastes ruficollis.

North Chin Foot-hills (Mackenzie) and round Bhamo, Kachin Hills (Harington). It has not been recorded from the Shan Hills.

41. The Black-throated Laughing-Thrush. Dryonastes chinensis leucogenys.

Only recorded so far in the Shan States. This is a fine bird going about in parties and behaving like *D. sannio* and as noisy and garrulous as the rest of the tribe. I have shot it in many places in the Shan States to try and find its breeding places but never succeeded.

I am quite sure it migrates, locally only perhaps, but in two different years I have noticed its arrival at a place near Taunggyi at the end of March or beginning of April, the birds being numerous and singing where there was not one to be seen before, and then after a few days the birds would disappear again towards the east. I thought and my idea is they breed, if in Burma at all, near China (Yunnan) and Siam. Hopwood, however records (Vol. xxvi, page 855) of the *Journal* the finding of one nest of this bird on Nwalabo mountain in Tennasserim. Eggs, skim-milk blue in colour 1·23″ × 88″. Harington's record, which he himself describes as doubtful, were white eggs and measured 1·04 × ·79, in fact the same size as *D. sannio*.

Two eggs said to be of this species sent me by a friend from a place over 100 miles East of Taunggyi were very light blue and measure the same as Hopwood's, but I doubt the authenticity.

42. **The Kachin Hills Laughing-Thrush. Dryonastes cærulatus kaurensis.**

Only the Kachin Hills (Harington and Grant). Grant obtained eggs early in June.

43. **The White-browed Laughing-Thrush. Dryonastes sannio.**

Very common in both the Kachin and Shan Hills, Mr. Stuart Baker in the *Fauna* says it occurs in the Chin Hills. I never came across it nor does Mackenzie record it ; however I only mention this as proof against it being common in these hills, as stated in the *Fauna* under *habits*.

The description given by Mr. Stuart Baker in the *Fauna* is all that one can want.

In my experience the commonest nesting site in the Shan States is low down in brambles or other bushes. The eggs are generally white, but Cook curiously states that all his eggs, taken in April, were of the light blue type which he took at Kalaw, a place some 40 miles to the west of Taunggyi and near the valley.

44. **Austen's Laughing-Thrush. Dryonastes galbanus.**

This species of *Dryonastes* appears to occur only in the Chin Hills. Late April and May according to Mackenzie is the nesting season.

45. **The Himalayan White-crested Laughing-thrush. Garrulax leucolophus leucolophus.**

Records show that the subspecies occupies the west of Burma, which means the Chin and Kachin Hills.

46. **The Burmese White-crested Laughing-Thrush. Garrulax leucolophus belangeri.**

This race inhabits the East of Burma, i. e. east Kachin and Shan Hills. More noisy than *Dryonastes*, which is saying a good deal. When taking a nest in the North Shan States, at about 3,500 ft., which by the way had an egg of *H. sparverioides* in it, I was almost mobbed by a whole party of them, friends no doubt of the owners of the nest. Other birds also called up to witness the robbing were *G. pectoralis* and *O. emeria*, all giving vent to their feelings of sympathy. May seems the best month for eggs in the Hills.

47. **The Burmese Black-gorgeted Laughing-Thrush. Garrulax pectoralis.**

48. **The Indian Necklaced Laughing-Thrush. Garrulax moniliger.**

Both these very similar birds inhabit all these three Hill countries and seemingly are found in the same jungle.

The 'Buff-ended' subspecies do not occur in these hills. I have a clutch of 4 *G. pectoralis* with 5 of *C. coromandus* eggs taken on the 1st of May. I have also noted the finding of a nest nearly on the ground in grass, a rare position, and shot the bird off it.

49. **The Ashy Laughing-Thrush. Ianthocincla cineracea cineracea.**

The Chin Hills only.

50. **Styan's Laughing-Thrush. Ianthocincla cineracea styani.**

Occurs in the East Shan States, but I have no record of it. A chance for some one to collect it in the Kengtung State ! I obtained the nest and eggs *I.c. cineracea* in the South and North Chin Hills, Mackenzie, still further north, took many nests and gives an interesting description of the nest, etc. (*Journ. Bom. Nat. Hist. Soc.*, vol. xxv, p. 77). He does not however give the number of eggs he found. As a rule, I have noted 2 only in the few nests I have taken myself.

51. **Hartert's Laughing-Thrush. Ianthocincla rufogularis assamensis.**

Chin Hills.

52. **The Chin Hills Laughing-Thrush. Ianthocincla austeni victoriæ.**

Only recorded apparently from the South Chin Hills.

53. **Hume's Red-headed Laughing-Thrush. Trochalopterum erythrocephalum erythrolæma.**

Chin Hills only. Mackenzie has given a good account of this bird's nesting. (*Journ. Bomb. Nat. Hist. Soc.*, vol. xxv, p. 78.)

54. **Wood's Red-headed Laughing-Thrush. Trochalopterum erythrocephalum woodi.**

55. **Blyth's Red-headed Laughing-Thrush. Trochalopterum erythrocephalum melanostigina.**

The above two subspecies occur in the Shan States.

56. **The Sikhim Red-headed Laughing-thrush. Trochalopterum eythrocephalum nigrimentum.**

Recorded from the Kachin Hills.

57. **The Burmese Crimson-winged Laughing-Thrush. Trochalopterum phœniceum ripponi.**

Kachin Hills and Shan States. I can record it right away to the most eastern limits (Kengtung State). A bird shot by me on the 30th March at an elevation of 4,000 ft. showed no signs of breeding, but about a fortnight later I saw many pairs going about together and they were calling a great deal. They certainly occurred only in the higher parts and seemed to prefer old clearings in heavy jungle.

58. **The Assam Crimson-winged Laughing-Thrush. Trochalopterum phœniceum bakeri.**

Recorded by Mackenzie from the North Chin Hills where he took the nests.

59. **The Burmese Red-tailed Laughing-Thrush. Trochalopterum milnei sharpei.**

Kachin Hills and North Shan Hills. Harington records it in the former and I have myself shot the bird in the N. Shan States (Taungpeng Hills) at about 5,000 ft. one of a party of ten or a dozen which came out of the jungle on to the road. This party was feeding in the densely covered *nullahs* which occur among the Shan Tea gardens. Harington took the nest in the Kachin Hills.

60. **The Blue-winged Laughing-Thrush. Trochalopterum squamatum.**

According to the *Fauna*, found in all these hills, but Harington's record in the Kachin Hills seems to show that it is a rare bird.

61. **The Manipur Streaked Laughing-Thrush. Trochalopterum virgatum.**

A Brahamaputra bird, coming down to the Chin Hills only. Mackenzie records it. He obtained a nest with incubated eggs, May.

62. **Austen's Striated Laughing-Thrush. Grammatoptila striata austeni.**

Mackenzie's record of this bird in the North Chin Hills is new. He took a nest with eggs (fresh) on 29th April.

63. **The Spotted-breasted Laughing-Thrush. Stactocichla merulina merulina.**

Remarks above apply. Only the nest of this bird was taken the 27th April.

64. **The Chinese Babax. Babax lanceolatus lanceolatus.**

Kachin Hills and North Shan States.

65. The Mt. Victoria Babax. Babax lanceolatus victoriæ.

Occurs in the South Chin Hills. The nest of one which I took just below Mt. Victoria was high up in a tree and not a bit difficult to find. The skin, if I remember correctly, of the parent bird is in the Society's Museum where it was kindly identified—2 blue eggs, April. Venning's eggs must have come, I think, from 50 or 60 miles further north.

66. The Striated Babbler. Argya earlii.

Recorded in the *Fauna* as occurring in the Chin Hills—the only place I ever saw it in Burma and took its nest was in the plains near Rangoon. Probably only to be found in the valleys bordering on the Hills as recorded by Harrington at Bhamo. The whole of Burma is very poorly represented by the genera *Turdoides* and *Argya* although the latter is represented by *A. gularis*, a Burmese bird of the Dry Zone.

67. Grant's Slaty-headed Scimitar-Babbler. Pomatorhinus schisticeps mearsi.

Recorded from the Chin Hills only, differs in no way from its confreres. The nests I found on the Mt. Victoria range were on the hill-side, on the ground just above the edge of the road-cutting at low elevations. The bird slips off and down the 'Khud' pretty quickly. Generally 3 eggs; middle of April and perhaps earlier.

68. Tweeddale's Scimitar-Babbler. Pomatorhinus schisticeps nuchalis.

Appears to be confined to South Burma and the South Shan States only in the area dealt with in these notes; Prome mentioned in the *Fauna* is in the West of Burma and Harington in his notes on the *Timelidæ* and their allies records a specimen obtained from Mt. Popa in the dry zone.

69. Harrington's Shan Scimitar-Babbler. Pomatorhinus olivaceus ripponi.

The east of Burma; a very common bird throughout the Shan States. 'What! What! (pause) What! What!' expresses, when quickly said, the common call of the bird. A bird of scrub jungle, and open cultivated spaces, seen round villages: likes the top of a stump of a tree or even a pine-apple bush as a nesting site, but often builds in the grass edges of banks of streams and sometimes even on the ground in Jungle. Middle of April seems the best time. Eggs 2 or 3, generally the latter; the young are clothed in black down.

70. Phayre's Coral-billed Scimitar-Babbler. Pomatorhinus ferruginosus phayrei.

Mackenzie records this from the North Chin Hills.

71. Baker's Rufous-necked Scimitar-Babbler. Pomatorhinus ruficollis bakeri.

North Chin Hills and through the Kachin Hills into Yunnan. Recorded by Mackenzie in the former locality and Harington in the latter.

72. McClelland's Scimitar-Babbler. Pomatorhinus erythrogenys macclellandi.

Chin Hills—very common. The nest I took of the bird in the Chin Hills was on the ground and at the bottom of a small hollow—a domed nest as usual. April is the month.

73. David's Scimitar-Babbler. Pomatorhinus erythrogenys gravivox.

Apparently a Kachin Hills subspecies.

74. Salvadori's Scimitar-Babbler. Pomatorhinus erythrogenys imberbis.

Shan States only apparently.

Cook describes its nest in his articles on the Birds of Kalaw (*Journ. Bomb. Nat. Hist. Soc.*, vol. xxii, p. 200). I only found young in the nest at Taunggyi, 23rd April. The nest was curiously placed, as Cook describes his find, in a place where it could have easily been trodden on by cattle. The nest was on the ground and rather difficult to see, but the parent birds were both very agitated and showed no fear.

75. The Arakan Scimitar-Babbler. Pomatorhinus hypoleucus hypoleucus.

Chin Hills only.

76. **The Burmese Red-capped Babbler. Timalia pileata jerdoni.**

Evidently to be found in all three areas, but it is a wonder that the Bengal subspecies (*bengalensis*) does not come down to the Chin Hills. I have found it in suitable places in the Shan Hills up to 5,000 ft. A common bird nesting on the ground ; mostly a domed nest.

77. **The White-headed Shrike-Babbler. Gampsorhynchus rufulus rufulus.**

I only came across this bird in the Arrakan Hills and I do not know how far north it extends, but the *Fauna* records its occurrence in the Chin Hills—Harington away north in the Kachin Hills.

78. **The Indian Yellow-eyed Babbler. Pyctorhis sinensis sinensis.**

Ubiquitous—a bird to be congratulated, considering the extent of its distribution and its numbers, in not having evolved any subspecies in Burma. I should like to call attention to its song, because on first hearing it I had a fine hunt and eventually secured what I had hoped would be something new.

79. **The Malay Spotted-Babbler. Pellorneum ruficeps subochraceum.**

Harington, Mackenzie and Cook give the subspecies as *minus* Sharpe's Spotted Babbler, for Kachin Hills, Chin Hills, and Shan Hills, but birds from Maymyo in Shan Hills have been identified as *subochraceum*. I have shot some myself and a skin was identified for me in England as '*minus*' as far as East as the Salween River in the Shan Hills. Harington in his notes on the Timeliides locates this subspecies (*sub-ochraceum*) in the South, even South of the Shan Hills and as he had access in writing these notes to skins from Maymyo, it is probable that birds from there were wrongly identified and these subspecies excluded from my areas. Mr. Stuart Baker in the *Fauna* also notes he is puzzled about the distribution of these two subspecies.

80. **Rippon's Babbler. Pellorneum ignotum cinnamomeum.**

Seems universally distributed in the hills of Upper Burma.

81. **Tickell's Babbler. Pellorneum tickelli tickelli.**

Mackenzie records it in the Chin Hills. A species which apparently comes down to Assam *via* the western area of Burma and down the Burmese peninsula of Tennasserim, avoiding the Shan Hills, a part of Burma where the species is not represented.

82. **Venning's Wren Babbler. Turdinulus brevicaudatus venningi.**

Southern Shan Hills.

83. **Baker's Wren Babbler. Turdinulus epilepidotus bakeri.**

Southern Shan Hills.

84. **Abbott's Babbler. Malacocincla sepiaria abbotti.**

Probably occurs in the lower Hills of all these three areas but I had only a personal acquaintance with it in the plains near Rangoon.

85. **The Assam Black-throated Babbler. Strachyris nigriceps coltarti.**

86. **The Malay Grey-throated Babbler. Strachyris nigriceps davisoni.**

The former subspecies seems to inhabit all the three areas being dealt with ; but in the S. Shan Hills birds are stated to be intermediate.

87. **The Nepal Golden-headed Babbler. Strachyris chrysæa chrysæa.**

Kachin Hills. (Harington) North Chin Hills.

88. **The Chin Hills Golden-headed Babbler. Strachyris chrysæa binghami.**

Chin Hills.

89. **The Burmese Golden-headed Babbler. Strachyris chrysæa assimilis.**

South Shan Hills.

90. **The Bhamo Red-headed Babbler. Stachydridopsis ruficeps bhamoensis.**

Kachin Hills and South Shan States.

NOTES ON THE BIRDS OF THE UPPER BURMA HILLS.

Mid-East Shan Hills. Valley 3,000 feet.

Typical country Northern Shan States. Elevation over 6,000 feet.
Chin Hills are similar.

Typical country Southern Shan States.
Mongyai valley 3,000 feet. Hills round rising up to 8,000 feet.

91. The Yellow-breasted Babbler. Mixornis rubricapilla rubricapilla.

Chin, Kachin and Shan Hills. The bird is said to be more of a plains bird, but I have taken a nest in the Hills at about 3,000 feet, probably its limit. Apparently a bird with very variable plumage.

92. The Nepal Babbler. Alcippe nepalensis nepalensis.

Chin Hills.

93. The Shan Hills Babbler. Alcippe nepalensis fratercula.

Kachin and Shan Hills.

94. The Arakan Quaker-Babbler. Alcippe poioicephala phayrei.

Recorded by Mackenzie in the Chin Hills.

95. The Upper Burma Quaker-Babbler. Alcippe poioicephala haringtoniæ.

Harington records this subspecies, in the plains of the Kachin Country and North Shan Hills.

96. The Lower Burma Quaker-Babbler. Alcippe poioicephala magnirostris.

Recorded from the South Shan Hills.

97. The Assam Tit-Babbler. Schœniparus dubius mandelli.

Chin Hills.

98. Rippon's Tit-Babbler. Schœniparus dubius genestieri.

Kachin and Shan Hills.

99. The Chestnut-headed Babbler. Pseudominla castaneiceps castaneiceps.

Chin, Kachin and Shan Hills.

100. Godwin Austen's Fulvetta. Fulvetta vinipecta austeni.

Eggs taken by me at the end of April in the N. Chin Hills I attributed to this subspecies, but it may have belonged to the next *ripponi* fromMt. Victoria. This little bird is common in high evergreen forests of the Chin Hills.

101. Rippon's Fulvetta. Fulvetta ruficapilla sordidior.

Eastern Shan Hills.

102. The Long-tailed Sibia. Sibia picaoides picaoides.

According to the *Fauna* to be found in all the three areas, but it has curiously not been recorded by either Harington or Mackenzie in their notes on the birds of the Kachin and Chin Hills, nor have I come across it in the Shan Hills,

103. The Grey Sibia. Leioptila gracilis.

Col. Rippon recorded the bird from the Kachin Hills and it is the common species of Sibia in the Chin Hills. I took two nests on the 28th and 29th April. They were built about 12 ft. from the ground in the top fork of saplings. The eggs varied much in size, and in depth of blue of the ground colour.

104. Tickell's Sibia. Leioptila melanoleuca melanoleuca.

105. Radcliffe's Sibia. Leioptila melanoleuca radcliffei.

The common Sibias of the Shan Hills are the two above subspecies, if they *are* separate subspecies ! I have taken two nests of *radcliffei*; the eggs vary ; in one case they were like my *gracilis* eggs in colouration, in the other a light blue ground very sparingly spotted. I should call them blackbird and thrush types, but the spots are dark red. One nest, 24th March, was built more against than on a branch of a pine tree just out of ordinary reach. Pine needles, and grass and a few leaves had been used with pine-needle lining, and it was coated outside with wool giving the whole a greyish appearance ; a bit of string and a bit of paper also decorated the outside. The structure measured 65 mm. inside and 110 mm. in diameter outside. This nest was in the hedge of a house compound, the other (28th March) being in a roadside tree. I discovered they were early breeders (end of March) by picking up a fully-fledged young bird at the end of April the year before. The skins I sent home have been identified as *radcliffei*. The call is like the description given of the species *castanoptera* (p. 306, vol. v of the 2nd Edition of the *Fauna*) rather mournful but not unmelodious and frequently uttered during the breeding season. It is particularly common round Taunggyi where I took one of the above-mentioned nests. It is a very quick rat-like mover amongst branches when feeding. I notice the eggs of the subspecies *melanoleuca* taken in Tennasserim were unspotted and the bird has a different note by Davison's description.

106. **Fea's Sibia. Leioptila castanoptera.**

Shan Hills. Cook identified a Sibia shot at Kalaw about 45 miles due west of Taunggyi as this.

107. **Blyth's Sibia. Leioptila annectens annectens.**

Recorded by Harington from Bhamo—Kachin Hills also according to the *Fauna* found in the Kachin Hills.

108. **Walden's Sibia. Leioptila annectens saturata.**

The Eastern Hills.—Kachin and Shan.

109. **Rippon's Bar-Wing. Actinodura egertoni ripponi.**

Chin and Kachin Hills.—Seemingly a rather curiously distributed bird. According to Harington, occupying the S. Chin Hills (Mt. Victoria) and the Kachin Hills (Bhamo) although Harington says his Kachin Hills skins more nearly resemble the subspecies *khasiana*. Nests taken by Harington at the end of April contained hard-set eggs ; so they are evidently early breeders.

110. **Ramsay's Bar-Wing. Actinodura ramsayi ramsayi.**

Shan States. I obtained this bird on the crags at Taunggyi (Plate I). One of a party of five or six in October, and although I saw them in the breeding season there, I never found the nest. The subspecies *radcliffei*, the Ruby mines Bar Wing is apparently a Northern Shan Hill bird only.

111. **The Chin Hills Bar-Wing. Ixops nipalensis poliotis.**

South Shan Hills.—Mt. Victoria.

112. **The Chestnut-headed Staphidia. Staphidia castaneiceps.**

Now recorded by Mackenzie from Chin Hills.

113. **Tickell's Staphidia. Staphidia striata striata.**

Apparently only in the Shan and Kachin Hills as Bhamo is in the Kachin and not Chin Hills as stated in the *Fauna*.

114. **Hume's Staphidia. Staphidia striata rufigenis.**

Harington obtained this subspecies also in the Kachin Hills.

115. **Hume's Siva. Siva strigula castaneicauda.**

Chin Hills. I once shot one in the Chin Hills, north of Falam, but identified it probably wrongly as the subspecies *strigula* ; occurs also in the Kachin Hills.

116. **Hodgson's Blue-winged Siva. Siva cyanouroptera cyanouroptera.**

Chin Hills.

117. **The Yunnan Blue-winged Siva. Siva cyanouroptera wingatei.**

Shan Hills and Kachin Hills.

118. **Oates's Siva. Siva cyanouroptera oatesi.**

Very south part of Shan Hills and apparently only discovered on the western border of these Hills.

119. **Sharpe's Yuhina. Yuhina gularis yangpiensis.**

The subspecies is distributed from the hills south of the Brahmaputra to the Chin Hills, Shan Hills and Yunnan where the next species is also found.

120. **Rippon's Yuhina. Yuhina diademata ampelina.**

This latter bird is recorded by Harington from the Kachin Hills—breeding April and May.

121. **The Black-chinned Yuhina. Yuhina nigrimentum nigrimentum.**

Chin Hills.

122. **The Yellow-headed Ixulus. Ixulus flavicollis.**

The subspecies *baileyi* or *flavicollis* occur in the North Chin Hills ; *harterti* in the S. Chin Hills, Kachin Hills and Trans-Salween River, Shan Hills—a curious distribution.

123. **Oate's Ixulus. Ixulus humilis clarkii.**

Another 'sport' like *Siva oatesi* found on a hill on the extreme western border of the South Shan Hills.

124. **The White-bellied Herpornis. Erpornis xantholeuca xantholeuca.**

Chin, Kachin and Shan Hills at low elevation—An early breeder apparently.

125. **The Indian Red-billed Lithorix. Liothrix lutea callipyga.**

Chin Hills.

126. **The Yunnan Red-billed Liothrix. Liothrix lutea yunnanensis.**

Kachin Hills.

127. **The Nepal Cutia. Cutia nipalensis nipalensis.**

Recorded by Mackenzie from the North Chin Hills.

128. **The Red-winged Shrike-Babbler. Pteruthius erythropterus.**

Chin Hills.

129. **Tickell's Shrike-Babbler. Pteruthius æralatus.**

Kachin Hills. This species was not uncommon on the crags at Taunggyi, Shan States, but I could not find the nest.

130. **Hume's Shrike-Babbler. Pteruthius melanotis intermedius.**

Inhabits the Eastern Hills of Burma, i.e. Kachin and the Shan Hills.

131. **The Common Iora. Ægithina tiphia tiphia.**

Apparently this is the subspecies that inhabits all these three parts of Burma. It is very common.

132. **The Gold-fronted Chloropsis. Chloropsis aurifrons aurifrons.**

Seems to be distributed throughout these areas.

133. **The Orange-bellied Chloropsis. Chloropsis hardwickii hardwickii.**

Distributed as above. I found it near the most eastern point of Burma in the Shan Hills.

134. **The Burmese Chloropsis. Icterocephala chlorocephala.**

Also occurs in these three areas.

135. **The Silver-eared Mesia. Mesia argentauris argentauris.**

Chin, Kachin and Shan Hills.

VI.—Family PYCNONOTIDÆ

136. **The Burmese White-throated Bulbul. Criniger tephrogenys burmanica.**

Is stated to inhabit the Eastern Hills of Burma, east of the Salween River in the *Fauna*, from Yamethin to Moulmein. Yamethin is a place in the centre of Burma just north of Pyinmana. Moulmein is at the mouth of the Salween River.

137. **The Yunnan White-throated Bulbul. Criniger tephrogenys grandis.**

The subspecies is obtainable apparently in the N.-E. corner of the Shan Hills.

138. The Assam Black Bulbul. Microscelis psaroides nigrescens.

Nigrescens from Assam reaches the North Chin Hills.

139. The Burmese Black Bulbul. Microscelis psaroides concolor.

The Kachin and Shan Hills.

140. The White-headed Black Bulbul. Microscelis leucocephalus.

A bird omitted from the *Fauna*. Recorded from Taunggyi Shan Hills, (*Journ. Bomb. Nat. Hist. Soc.*, vol. xxix, p. 559). I saw a number of these birds in the company of *M.p. concolor* in the Northern Shan States in the month of January at about 5,000 ft. and noticed them in the breeding season on the crag at Taunggyi alone and very rare, and I am not sure if they actually bred. If it had not been that I actually observed them in the breeding season, one would have said they were cold weather visitants. Anyway they are more numerous in the cold weather; it is hoped the bird is extending its habitat westwards as it is a handsome species.

141. Thompson's Bulbul. Cerasophila thompsoni.

The occurrence of these birds in the Kachin Hills has also been observed. The finding of its nest in the Shan States has been recorded. (*Journ. Bomb. Nat. His. Soc.*, vol. xxx, p. 223). I have not any doubt now that it breeds in the Shan States and probably Kachin Hills but is not so common as in the cold weather. I was very unsuccessful in finding a nest after the one recorded.

142. The Himalayan Brown-eared Bulbul. Hemixus flavala flavala.

Chin and Kachin Hills.

143. Hildebrand's Brown-eared Bulbul. Hemixus flavala hildebrandi.

May be obtained in the Shan Hills.

144. The Rufous-bellied Bulbul. Hemixus macclellandi macclelandi.

In the Chin and Kachin Hills.

145. Tickell's Bulbul. Hemixus macclellandi tickelli.

In the South Shan Hills.

146. Hartert's Shan Bulbul. Hemixus macclellandi binghami.

Found in the Shan Hills. Harington records *Hemixus m. holti* from the Kachin Hills, but there is apparently some doubt on the subject. The *Fauna* asks for more specimens of the species from different parts of Burma.

147. The Striated Green Bulbul. Alcurus striatus.

Chin and Kachin Hills—Probably also throughout the Shan Hills in suitable elevations. I shot a specimen near Mt. Victoria and remarked it was behaving rather like the genus *Spizixus*.– Beginning to breed at end of April.

148. The Red-vented Bulbul. Molpastes hæmorrhous.

A species with seven subspecies. There seems to be some difficulty in separating the Burmese subspecies; *burmanicus*, the Burmese Red-vented Bulbul is found in the Chin and Kachin Hills (Harington) and the eastern edge of the Shan Hills. It is recorded from at least 40 miles east of Mandalay. Further east in the Shan Hills we get, according to the *Fauna*, the subspecies *chrysorrhoides*, the Chinese Red-vented Bulbul, which extends north into the Kachin Hills and Yunnan; the 3rd subspecies, *nigripileus*, the Tenasserim Red-vented Bulbul, being found south of Toungoo, i.e., not in the Shan Hills.

Personally this has upset my own ideas. I always assumed *chrysorrhoides* (late *atricapilla*) as the bird which inhabited Tennasserim and *nigripileus* as the north-eastern subspecies. I notice Cook identifies his *Molpastes* from the South Shan Hills, west of Taunggyi, as *nigripileus* and Harington says it occurs in Taunggyi itself and that birds about 50 miles east of Mandalay more nearly approached *nigripileus*. Harington identifies the Kachin *Molpastes* as *burmanicus*. Anyway it is satisfactory that the distribution only affects subspecies now. The detailed description of the subspecies. *M. h. nigripileus* is omitted in the new edition of the *Fauna*.

149. **Blyth's Bulbul. Xanthixus flavescens flavescens.**

Chin Hills.

150. **The Muleyit Bulbul. Xanthixus flavescens vividus.**

In the Shan and Kachin Hills. I have noted that a pair on the crags at Taunggyi took only six days to build their nest with two eggs complete. The nest was by no means an unsubstantial one. They appeared to me to always build very low down in thick bushes or even grass. End of April for fresh eggs.

151. **The Bengal Red-whiskered Bulbul. Otocompsa emeria emeria.**

Apparently the subspecies in the north of Burma, while *peguensis*, the Burmese Red-whiskered Bulbul occurs everywhere else. The latter is a new subspecies. This Bulbul is very easily tamed, coming into the house for food. I know of an instance of it nesting in grass in a vase in a drawing room.

152. **The Black-crested Yellow Bulbul. Otocompsa flaviventris flaviventris.**

Chin, Kachin and Shan Hills; but a bird of somewhat low elevations and very local—likes to be near water.

153. **The Finch-billed Bulbul. Spizixus canifrons canifrons.**

Chin and Kachin Hills. Early breeders, generally young by the end of April but I took eggs from a nest on the 28th of that month. The curious nest of tendrils has been often noted, there is no mistaking it. Prefers evergreen jungle at high elevations.

154. **The Olive Bulbul. Iole olivacea virescens.**

According to the *Fauna* distributed throughout Burma in the Chin, Kachin and Shan Hills.

155. **The Siam Bulbul. Iole olivacea lonbergi.**

I shot this bulbul in the Shan Hills at an elevation about 3,000 ft. Breeding 17th March.

156. **Anderson's Yellow-vented Bulbul. Pycnonotus auricaster xanthorhous.**

Shan and Kachin Hills.

157. **Davison's Stripe-throated Bulbul. Pycnonotus finlaysoni davisoni.**

Chin Hills.

158. **Blandford's Olive Bulbul. Pycnonotus plumosus blandfordi.**

Chin Hills—very doubtful; but I have had it breeding in my garden in the Shan Hills and it is said to occur in the Kachin Hills, but nowhere in the hills is it as common as in the plains. The dry zone of Burma is literally full of them; rather a scolding note. The nest is a very shallow and small cup, and the eggs never so richly coloured as other Bulbuls.

159. **The Black-headed Bulbul. Microtarsus melanocephalus melanocephalus.**

Ubiquitous; but by no means ever common. The only nest I found which was in the Shan Hills near Taunggyi, but at a good deal lower elevation—had one egg a little set. I notice in the *Fauna* that another species *M. poiocephalus* has this habit of only laying 1 egg.

VII.—Family CERTHIIDÆ

160. **The Yunnan Tree Creeper. Certhia himalayana yunnanensis.**

Shan Hills.

161. **The Chin Hills Tree Creeper. Certhia himalayana intermedia.**

Chin Hills.

162. **The Tibetan Tree Creeper. Certhia familiaris khamensis.**

Extreme North-east Kachin Hills.

163. **The Chin Hills Tree Creeper. Certhia discolor victoriæ.**

Apparently this subspecies and Hume's Tree Creeper (*C. d. manipurensis*) meet where Mackenzie worked in the North Chin Hills. (*Journ. Bomb. Nat. Hist. Soc.*, vol. xxv, p. 82) as he obtained both these subspecies and the nests the latter end of April and beginning of May.

164. **The Karenni Tree Creeper. Certhia discolor fuliginosa.**

Occurs in the Shan Hills in the east.

VIII.—Family TROGLODYTIDÆ

165. **The Yunnan Wren. Troglodytes troglodytes talifuensis.**

Shan Hills.

166. **Long-tailed Wren. Spelæornis longicaudatus.**

Kachin Hills (Harington). The two subspecies *sinlumensis* and *kauriensis* appear doubtful. *S. l. reptatus* occurs in the Shan Hills and *S. l. oatesi* in the Chin Hills.

167. **The Scaly-breasted Wren. Pnœpyga squamata squamata.**

Chin Hills.

168. **The Brown Wren. Pnœpyga pusilla pusilla.**

Chin and Kachin and Shan Hills.

169. **The Slaty-bellied Wren. Tesia cyaniventer cyaniventer.**

Chin and Kachin Hills.

IX.—Family CINCLIDÆ

170. **The Formosan Brown Dipper. Cinclus pallasii mariia.**

Is apparently the only Dipper which inhabits Burma and is the same as the Assam one. I have never shot one, but have watched them from quite near. They behave just like the English species, so far as my observations go. They seem to inhabit the big rocky streams only.

X.—Family TURDIDÆ

171. **The Indian Blue Chat. Larvivora brunnea.**

Apparently to be found in the North, i. e., Kachin Hills.

172. **The Chin Hills Blue Chat. Larvivora wickhami.**

Chin Hills. The nest taken by me in April, when I shot the parent bird, was on the side of a hill just above the road cutting at an elevation of about 5,000 ft.

173. **The White-browed Short-wing. Heteroxenicus cruralis.**

In all three Hills.

174. **The Nepal Short-wing. Heteroxenicus nipalensis nipalensis.**

Probably in all three Hills, but as yet unrecorded from the Shan Hills.

175. **The Chinese Short-wing. Heteroxenicus sinensis.**

Kachin Hills probably.

176. **The Burmese Stone-Chat. Saxicola caprata burmanica.**

Ubiquitous. Probably breeds more in the hills than in the plains and it is perhaps the commonest of the common birds of the country. Whereas some nests are beautifully hidden under a bush, like our English Stone Chat an empty tin or the hollow of a bamboo lying out in the open on the ground may be utilized; again a favourite site is a hole in a bank, the nest just placed in the edge or under a clod. I have seen a nest actually down a hole in the ground and one also in a small grassy hollow in a field, absolutely open and exposed to the weather. I suppose I have taken more cuckoos (*C. canorus*) eggs out of the nests of this species than nests of any other bird. One egg in the clutch is, like the House Sparrow, as a rule different in colouration to the others.

Although fresh eggs may be obtained in May, it begins to breed as a rule at the end of March.

177. **The Turkestan Bush=Chat. Saxicola torquata przewalskii.**

This is probably the subspecies of *S. torquata* which inhabits all our areas, although, according to the *Fauna indica* may be found in the north-west corner of Burma. In places where I have spotted it, it never seemed to stay to breed, but Harington is sure that it bred in the Kachin Hills. The *Fauna* records its breeding at a place called Monywa, but Monywa is not in the Chin Hills and there seems to be some mistake.

178. **The White=tailed Bush Chat. Saxicola torquata leucura.**

May be found in our areas although I have never noticed it in the Shan States. Mackenzie records its breeding in the plains.

179. **Jerdon Bush Chat. Oreicola jerdoni.**

I have only seen this bird in the plains in the valley of the Irrawaddy River, well north of Mandalay almost in Kachin country and Harington records it in Bhamo plain. Oates, in 1883, when he wrote his *Birds of Burma* said it had only once been recorded in British Burma, but noted its occurrence at Bhamo, not then in British Burma. Its occurrence in the 'upland grass plains' of the Chin Hills, as stated in the *Fauna*, I find difficult to believe, as, to start with, such plains are not present in any parts of these hills that I have been in.

180. **The Eastern Dark Grey Bush Chat. Oreicola ferrea haringtoni.**

A fairly common bird in all these hills. It certainly does not confine itself to open grass lands like the subspecies *ferrea* is stated to do. In habits it appears very different to *O. jerdoni* which enjoys open country. *O. f. haringtoni* likes the jungle although its nesting site is generally an open bank. Early April for fresh eggs.

181. **The Eastern Spotted Forktail. Enicurus maculatus guttatus.**

Chin Hills, where I shot the bird off the nest, Kachin Hills and Shan States. The nest I took was on a ledge of rock on the roadside cutting. Fresh eggs April 28th.

182. **The Slaty=backed Forktail. Enicurus schistaceus.**

All these hills, but personally I have only noted it in the Southern Chin Hills where I took its nest in the hollow stump of a tree leaning over a stream early in April. A bird, I should have thought, which preferred the larger streams near the valleys and not the wee streams up in the hills which *E. m. guttatus* delights in.

183. **The Black=backed Forktail. Enicurus immaculatus.**

Chin Hills and I procured it in the Shan States. The nest was under an overhanging bank in a very small water course which was dry but was within 40 or 50 ft. of a perennial stream ; May 14 being the date. In the plains I noted it as rather a later breeder than other Forktails.

184. **Leschenault's Indian Forktail. Enicurus leschenaulti indicus.**

The subspecies *indicus* inhabits the Chin and Kachin States, but the Shan States sub-species is designated *sinensis*, Leschenault's Chinese Forktail.

185. **The Little Forktail. Microcichla scouleri scouleri.**

The Upper Burma Hills. I should say an uncommon bird.

186. **The Blue=fronted Redstart. Phœnicurus frontalis.**

Chin, Kachin and Shan Hills. Breeds in the former and Northern Shan Hills.

187. **The Daurian Redstart. Phœnicurus auroreus.**

A winter visitor to the Shan Hills—Arrives about November.—Uncommon and timid. Another winter species of redstart which come to these Burma Hills is *P. hodgsoni*, Hodgson's Redstart.

188. **The Eastern Indian Redstart. Phœnicurus ochrurus rufiventris.**

I have seen this redstart as late as April in the Shan Hills.

189. **The White=capped Redstart. Chaimarrhornis lecuocephala.**

A winter visitor to all these hill streams.

190. **The Plumbeous Redstart. Rhyacornis fugilinosa.**

Also a winter visitor to the Northern Burma Hills.

191. **The Chinese Red-spotted Blue-throat. Cyanosylvia robusta suecica.**

A winter visitor.

192. **The Common Ruby throat. Calliope calliope.**

A winter visitor—November to April. Starts to sing before leaving us, a low, pleasant song uttered from a dense bush.

193. **The Golden Bush-Robin. Tarsiger chrysæus chrysæus.**

Recorded as occurring in the Chin Hills in the *Fauna* and, as it goes through to Yunnan, probably also to be found in the Kachin and Shan Hills.

194. **The Red-flanked Bush-Robin. Ianthia cyanura rufilata.**

Chin, Kachin and Shan Hills.

195. **The White-browed Bush-Robin. Ianthia indica indica.**

According to the *Fauna* does not seem to be recorded from the Chin Hills but only from the Kachin and Shan Hills. I may be wrong as I did not shoot it, but I considered I identified this bird just below Mt. Victoria, Chin Hills. The nest I found in a bank was destroyed by tree falling on it before eggs were laid. The birds were very tame and behaved like the English robin.

196. **The White-tailed Blue Robin. Notodela leucura.**

Occurs in these Northern Burma Hills.

197. **The Indian Magpie Robin. Copsychus saularis saularis.**

To be found everywhere in these hills where man stays.

198. **The Indian Shama. Kittacincla macroura indica.**

The Burmese name in the *Fauna* is wrong ; it is known to the Burmans as the jungle Magpie-robin and the prefix 'Tau' means jungle. 'Tauthapatelway' (see *C. s. saularis*) not 'Tai-tha-laik-swe.' The subspecies inhabiting these hills of Upper Burma seems to be *indica*. A shy bird, but in the breeding season will answer any attempt at copying its song.

In the Andamans, Osmaston got its subspecies *albiventris* to breed in nest boxes placed in the jungle, a fact which seems to have been overlooked in the *Fauna* as the nidification of this particular subspecies is said to be 'not recorded.'

199. **The Dusky Thrush. Turdus eunomus.**

A winter visitor to Burma.

200. **The Red-throated Thrush. Turdus ruficollis.**

A winter visitor to Burma.

201. **The Black-breasted Thrush. Turdus dissimilis.**

A resident species in the Chin, Kachin and Shan Hills. Mackenzie took the eggs in the Chin Hills in April and records it as fairly common.

202. **The Dark Thrush. Turdus obscurus obscurus.**

A winter visitor. Harington records it up to May in the Kachin Hills but does not think they bred there.

203. **Fea's Thrush. Turdus feæ.**

A resident of the Burmese Hills.

204. **The Siberian Ground-Thrush. Geocichla sibirica sibirica.**

This Thrush and *G. s. davisoni*, Davison's Ground-Thrush are winter visitors.

205. **The Orange-headed Ground-Thrush. Geocichla citrina citrina.**

Without reading other descriptions I should have said it was a bird of the higher elevation, 4,000 ft. in heavy jungle in Burma. It is common on the crags at Taunggyi, but I did not meet with it often elsewhere in those hills except where such similar jungle existed and such places are uncommon in the Southern Shan Hills. Eggs end of May.

206. **The Small-billed Mountain-Thrush. Oreocincla dauma dauma.**

Apparently resident in our area.

207. **White's Thrush. Oreocincla aurea aurea.**

208. **The Plain-backed Mountain-Thrush. Oreocincla mollisima.**

This and the above named species are only winter visitors.

209. **The Large Brown Thrush. Zoothera monticola.**

All the hills. I found it in the Chin Hills, but not common.

210. **The Chestnut-bellied Rock-Thrush. Monticola erythrogastra.**

A common bird of the hills. It has a habit of building its nest in the cuttings of the hill roads. Nests in April.

211. **The Blue-headed Rock-Thrush. Monticola cinclornyncha.**

Breeds in the Chin and Kachin Hills. Mackenzie records its nesting even further south—Probably a winter visitor to Shan Hills.

212. **The Burmese Blue Rock-Thrush. Monticola solitaria affinis.**

This is the Burmese subspecies of the Blue Rock-Thrush; a winter visitor to most of our area but said to breed probably in the very north. This is a familiar bird which is noticed by many people on account of its lonely habits and the frequency with which it visits our dwellings, perching on the roofs, etc. Although not really shy, it always has the appearance of being frightened and never looks contented.

213. **Swinhoe's Rock-Thrush. Monticola gularis gularis.**

I am sure I saw this species on the crag at Taunggyi, Shan Hills in March, but I had no gun with me to procure it. It does not appear to enter the Chin and Kachin Hills.

214. **The Rock-Thrush. Monticola saxatilis.**

A winter visitor.

215. **The Himalayan Whistling-Thrush. Myiophoneus temmincki temmincki.**

The subspecies in the Chin and Kachin Hills.

216. **The Burmese Whistling-Thrush. Myiophoneus temmincki eugenii.**

The Shan Hills. A pair of these birds always frequented the foot of the Taunggyi crags well away from any stream, but I never discovered its nest there. Its liking for streams is of course well-known.

217. **The Purple Thrush. Cochoa purpurea purpurea.**

This and the Green Thrush, *Cochoa viridis* are both inhabitants of these hills.

218. **Rippon's Hedge-Sparrow. Laiscopus collaris ripponi.**

Recorded only from the North Shan Hills, but I expect it could be found in the Kachin Hills too. Apparently the only representative of this sub-family in Burma.

XI.—Family MUSCICAPIDÆ

219. **The Sooty Flycatcher. Hemichelidon sibirica cacabata.**

Is the subspecies in this area. The *Fauna* says north-east Burma but this little flycatcher certainly inhabits the north-west Hills, i.e., Chin Hills.

220. **The Yunnan Sooty Flycatcher. Hemichelidon sibirica rothschildi.**

Probably in the Shan Hills.

221. **The Ferruginous Flycatcher. Hemichelidon cinereiceps.**

In all these hills. Macdonald found its nest on Mt. Victoria, the eggs very hard set on 13th May.

222. **The Orange-gorgeted Flycatcher. Siphia strophiata.**

A winter visitor throughout.

223. **The Eastern Red-breasted Flycatcher. Siphia parva albicilla.**

Also a winter visitor only.

224. **The Rusty-breasted Blue Flycatcher. Cyornis hodgsoni.**

In all these hills.

225. **The Eastern Slaty-blue flycatcher. Cyornis tricolor cerviniventris.**

An inhabitant of the Chin, Kachin and Shan Hills. I found it breeding in the former, and a bird from the Chin Hills shot off a nest is in the Society's Museum. Small moss nests placed in a hole or on a small ledge of roadside cutting generally without lining, but sometimes a few moss roots. The eggs look a dark buffy white—Beginning of May or end of April for eggs.

226. **The Little Blue and White Flycatcher. Cyornis superciliaris astigma.**

Chin and Kachin Hills.

227. **The Burmese Little Pied Flycatcher. Cyornis melanoleuca.**

228. **The Burmese Little Pied Flycatcher. Cyornis melanoleuca westermanni.**

Chin Kachin and Shan Hills. Although often met with, it is by no means a common bird and very unobtrusive.

229. **The Sapphire-headed Flycatcher. Cyornis sapphira.**

Chin and Kachin Hills.

230. **The Rufous-bellied Blue Flycatcher. Cyornis vivida oatesi.**

Chin and Kachin and Shan Hills.

231. **The Pale Blue Flycatcher. Cyornis unicolor unicolor.**

Chin Hills.

232. **The Blue-throated Flycatcher. Cyornis rubeculoides rubeculoides.**

All three hill areas. Mackenzie records it as common in the Chin Hills and took its eggs early in May in the Chin Hills.

233. **Salvadori's Blue Flycatcher. Cyornis banyumas dialilæma.**

Kachin Hills east of Irrawaddy and Shan Hills. I found this bird common in the latter and it breeds on the crags at Taunggyi. I shot the female off a nest, but this hardly helped me to identify the species and I subsequently got a male. The nests are neat and well hidden against the moss green trunk of a tree, sometimes quite low down. I found the nests in May and June, but I believe they also sometimes breed much earlier than this as I shot a young fully-fledged male early in March. This young bird had a blue tail and a bluish tinge to all its feathers ; it was with its parents.

234. **Tickell's Blue Flycatcher. Cyornis tickelliæ tickelliæ.**

In all three hills. I procured a specimen as far south as Mt. Victoria.

235. **The Large-billed Blue Flycatcher. Cyornis magnirostris.**

I shot a specimen which I identified as this in the North Shan Hills in the rains. The *Fauna* does not place it as a Burman species, so I may have been wrong.

236. **The Verditer Flycatcher. Stoparola melanops melanops.**

Any of these hills, as the *Fauna* says, over 4,000 ft. A common bird and particularly partial to nesting along roadsides.

237. **Sharpe's White-gorgetted Flycatcher. Anthipes monileger leucops.**

Chin Hills and probably Shan Hills.

238. **Brooks' Flycatcher. Anthipes olivaceus poliogenys.**

Chin Hills the *Fauna* says as far east as the Irrawaddy River ; perhaps their area comprises also the Kachin Hills therefore.

239. **The Sumatran Brown Flycatcher. Alseonax latirostris latirostris.**

I understand an entirely winter visitor to our hills and plains.

240. **The Grey-headed Flycatcher. Culicicapa ceylonensis ceylonensis.**

Apparently the subspecies in the north-west and *C. c. orientalis*, the Chinese Grey-headed Flycatcher in the north-east. Shan Hills. Breeds from end of March into April: neat nests, against a rock or tree trunk of moss, covered with spiders' egg cocoons.

241. **The Large Niltava. Niltava grandis.**

Chin Hills and Kachin Hills. Breeds end of April at well over 3,000 ft. elevation.

242. **The Indian Rufous-bellied Niltava. Niltava sundara sundara.**

Chin Hills and Kachin Hills, probably Shan Hills. It breeds quite commonly in the former hills and I found it as far south at Mt. Victoria. Breeds end of April often in holes of roadside cuttings at an elevation about 3,000 ft.

243. **The Small Niltava. Niltava macgrigoriæ.**

Chin, Kachin and Shan Hills. Harington took a nest at the end of April in the Kachin Hills.

244. **The Burmese Paradise Flycatcher. Tersiphone paradisi affinis.**

Chin, Kachin and Shan Hills much more common in the valleys than at higher elevations. Breeds April.

245. **The Northern Indian Black-naped Flycatcher. Hypothymis azurea styani.**

A fairly common bird in all these hills.

246. **The Yellow-bellied Flycatcher. Chelidorhynx hypoxanthum.**

Throughout these hills, but I do not know it personally ; it seems a bird of high elevations. Harington found it breeding in the Kachin Hills about the middle of April.

247. **The Burmese White-browed Fantail Flycatcher. Rhipidura aureola burmanica.**

Chin, Kachin and Shan Hills. I have obtained the nest at about 5,000 ft. on the Taunggyi crag, 21st March, but this seems early.

248. **The White-throated Fantail Fly-catcher. Rhipidura alibicollis albicollis.**

In all three hills; Macknezie took its eggs in the Chin Hills at the end of April.

XII.—Family LANIDÆ

249. **The Burmese Shrike. Lanius colluroides.**

Chin, Kachin and Shan Hills ; in the latter it is a very common breeder and undoubtedly moves up from the plains to breed.

250. **The Indian Black-headed Shrike. Lanius nigriceps nigriceps.**

Distributed as above but not such a common bird.

251. **The Grey-backed Shrike. Lanius tephronotus.**

Apparently only a winter visitor to Burma.

252. **The Philippine Shrike. Lanius cristatus lucionensis.**

A winter visitor, but I have seen it in the Shan Hills up to April. The song of this bird always reminded me of a sedge warbler at home and is also like the Thick-billed Warbler, *Phragmaticola ædon.*

253. **The Brown-backed Pied Shrike. Hemipus picatus capitalis.**

All Burmese Hills.

254. **The Nepal Wood Shrike. Tephrodornis pelvica pelvica.**

All the Burmese Hills. I shot it at 5,000 ft. on the Taunggyi crag. In company with others, the bird was hunting in the top branches of the higher trees. I cannot find any note of the nest being found in Burma, but it must breed in that country.

255. **The Indian Common Wood-Shrike. Tephrodornis pondiceriana pondiceriana.**

Chin, Kachin and Shan Hills. The nest taken at the beginning of April in the Shan Hills 3,000 ft. was in scrub jungle about 8 ft. above ground in a small tree standing by itself ; very shallow cup ; outside moss and lichen. Lined hair. In the plains the bird, I think, breeds later and often higher up.

XII.--Family PERICROCOTIDÆ

256. **The Burmese Scarlet Minivet. Pericrocotus speciosus fraterculus.**

Chin, Kachin and Shan Hills.

I once found the nest of this bird in the Chin Hills and twelve years after, almost to the day, there was a nest in, as far as I could remember, the same tree.

257. **The Assam Short-billed Minivet. Pericrocotus brevirostris affinis.**

Kachin and Shan Hills probably. I should say the Chin Hills. I found a nest on the top of the Taunggyi Hills, Shan Hills, and shot both parent birds on 22nd March 3 eggs fresh, the nest and eggs similar to other minivets.

258. **Hume's Minivet. Pericrocotus neglectus.**

Recorded by Col. Rippon, according to Harington, from the Kachin Hills which is some way from Tennasserim, the habitat of this bird according to the *Fauna*. There may be a mistake ?

259. **The Yellow-throated Minivet. Pericrocotus solaris solaris.**

The Chin and Kachin Hills.

260. **The Shan Minivet. Pericrocotus solaris ripponi.**

Shan Hills.

261. **The Rosy Minivet. Pericrocotus roseus roseus.**

Chin, Kachin and Shan Hills. I remember Osmaston taking a nest in the latter hills.

262. **The Burmese Small Minivet. Pericrocotus peregrinus vividus.**

Common everywhere and breeding well up to 3,500 ft. I once found the nest of this minivet only two feet above the ground, but generally they are well out of reach. Eggs beginning of May.

263. **Jerdon's Minivet. Pericrocotus albifrons.**

In the *Fauna* said to occur in the Chin Hills, but I doubt this and believe it is only a bird of the dry zone of Burma.

264. **The Pale-grey Cuckoo-Shrike. Lalage melaschista avensis.**

Chin, Kachin and Shan Hills. I have taken the nest at Taunggyi, Shan States about 4 to 5,000 ft. It was placed fairly high up in a fork of a branch almost like a drongo's. 3 fresh eggs end of April.

265. The Black-headed Cuckoo-Shrike. Lalage sykesii.

Mackenzie records this bird from the North Chin Hills.

266. The Siamese Large Cuckoo-Shrike. Graucalus macei siamensis.

Chin, Kachin and Shan Hills. The raucous cry of this bird can be often heard. It has a wonderfully neat and small nest for its size, generally high up and in a tree fork, rendering it difficult to see.

Mackenzie took eggs at the end of April in the Chin Hills and I took eggs at Maymyo at end of May, but I think this was unusually late. Generally 2 eggs.

XIV.—Family ARTAMIDÆ

267. The Ashy Swallow-Shrike. Artamus fuscus.

Chin, Kachin and Shan Hills. A bird of the plains and hills alike. The description of their habits in the *Fauna* seems very good and brings out their characteristics well.

XV.—Family DICRURIDÆ

268. The Crow-billed Drongo. Dicrurus annectens.

Distributed throughout these hills but the Field naturalists who have collected birds in Burma do not seem to have recorded it. Presumably they are so like the next species ! they have not been shot and identified and seem to have been missed. I certainly have never noticed it, nor handled a specimen.

269. The Black Drongo. Dicrurus macrocercus.

Apparently of this species the subspecies *D. m. albirictus*, the Himalayan Black Drongo is found in the north and *D. m. cathæcus*, the Chinese Black Drongo in the southern portion of these hills. End of April and beginning of May seems the breeding time.

270. The Grey Drongo. Dicrurus leucophæus.

According to Mr. Stuart Baker, the subspecies which inhabits the north of our area is *hopwoodi*, the Assam Grey Drongo and in the south *nigrescens*, the Burmese Grey Drongo, this applying to the Kachin Hills (please see map.) The distribution is difficult to understand, and the same remarks apply to the subspecies of *macrocercus*. I have taken the eggs of this species all over the Shan Hills and on the last occasion shot the bird to the east of Mandalay and should have said it was *hopwoodi*, but to really identify these subspecies one wants a series of skins for comparison. They begin to nest at the end of March in the Shan States : the nest is not as a rule difficult to find as the birds return to it fearlessly. The eggs seem to me to be always squat ovals and not like the Black Drongo's in shape and as a rule very much more handsome in colouration.

271. The Northern Bronzed Drongo. Chaptia ænea ænea.

Chin, Kachin and Shan Hills. I found this bird breeding late in March at Taunggyi, Shan Hills and noted young birds on 19th of that month further east but Mackenzie took them a month later in the Chin Hills.

272. The Indian Hair-crested Drongo. Chibia hottentotta hottentotta.

A common bird in all our hills, breeding end of April. The nests I note are very untidy cradles and one cannot understand what governs the choice of site for more variable sites for nests it is difficult to find. Sometimes hidden away in jungle, sometimes overhanging a highway, sometimes very high and out of reach and sometimes quite low enough to reach by hand by pulling the branch down a little.

273. The Indian Lesser Racket-tailed Drongo. Bhringa remifer tectirostris.

Chin and Kachin and Shan Hills. Mackenzie says breeds sometimes quite low down and I have noticed this myself. Breeds end of April.

274. **The Large Racket-tailed Drongo. Dissemurus paradiseus.**

A third species of these drongos which appears to vary sufficiently in size to enable different subspecies to be created. The subspecies inhabiting the northern range is *D. p. grandis*, the Assam Large Racket Tailed Drongo, and the southern *D. p. rangoonensis*, the Burmese Large Racket-tailed Drongo. This species never seems to build low down and the nests are very difficult to get. Breeds end of April.

XVI.—Family Sylviidæ

275. **Mrs. Stevens's Reed-Warbler. Acrocephalus stentoreus amyæ.**

Is now known to breed in the Shan Hills on the Lake below Taunggyi about 3,000 ft. Captain Livesey found its nests in the middle of June and the bird was identified for me by Mr. Stuart Baker. The birds are numerous on the lake and probably are winter visitors to the plains. They build in the rushes on the islands mostly and make a typical reed warbler's nest. Captain Livesey told me there were two varieties of colouration in the eggs, as described in the *Fauna* in the nidification of *A. s. brunnescens*. It is curious that the breeding of this bird escaped the notice of Col. Rippon, Harington and others.

276. **Schrenck's Reed-Warbler. Acrocephalus bistrigiceps.**

Stated to occur in the Chin and Kachin Hills as a winter visitor. It is probable that other reed warblers come over to Burma in the winter, but live mostly in the plains.

277. **Pallas's Grasshopper Warbler. Locustella certhiola.**

278. **The Streaked Grasshopper-Warbler. Locustella lanceolata.**

Chinese birds said to winter in Burma and might therefore be found in the N. Burma hills.

279. **The Chinese Bush-Warbler. Tribura taczanowskia.**

Winter visitor to Burma may be found in these Hills.

280. **The Brown Bush-Warbler. Tribura luteoventris.**

Chin Hills only apparently.

281. **The Burmese Tailor-Bird. Orthotomus sutorius patia.**

Throughout these hills but not at the higher elevations. The subspecies *O. s. longicaudus*, the Chinese Tailor-Bird, is recorded from the Northern Shan States. A darker bird, but apparently from the measurements given in the *Fauna*, not well named. Breeds from April and on, mostly in the rains I think.

282. **The Burmese Black-necked Tailor Bird. Orthotomus atriguiaris nitidus.**

Probably occurs in these hills.

283. **The Yellow headed Fantail-Warbler. Cisticola exilis tytleri.**

Throughout these hills in special localities seemingly ; personally I never spotted it.

284. **The Streaked Fantail-Warbler. Cisticola juncidis curstians.**

Throughout the Upper Burma hills but rare in the Chin Hills, chiefly because there is little if any suitable country. For so small and apparently feeble a flier this little warbler makes extraordinary undulating flights, uttering its sharp note on the ' up gradients.' Its nest is a picture of bird architecture, a small edition of *Suya*, and it seems to have a habit of making a trial nest or two before making a final approval of the nursery. I have noted it as being cuckolded by *Cacomantis merulinus*. Starts breeding in May and goes on throughout the rains, even up to the end of September.

285. **Franklin's Wren-Warbler. Franklinia gracilis.**

Chin, Kachin and Shan Hills.

One year it was particularly common at Maymyo in the Shan Hills east of Mandalay and Osmaston found several nests, two of which had been used by the

NOTES ON THE BIRDS OF THE UPPER BURMA HILLS.

A.

B.

C.

A. R. Irrawaddy at its second defile just below Bhamo Hills occupied by Kachins.

B. The Bhamo Plain. R. Irrawaddy Valley as viewed from Kachin Hills. 3,000 feet.

C. Kachin Hills. 5,000 feet. Typical view.

above named Cuckoo. In subsequent years I found them less common. It is a bird of the open scrub jungle. Eggs found mostly end of May and beginning of June. The nest is like that of *O. sutorius*, but lined with grass only, and never higher than 2 or 3 feet off the ground.

286. **Beavan's Wren-Warbler. Franklinia rufescens rufescens.**

A bird of all these Upper Burma Hills, but more of an inhabitant of jungle than *gracilis*. Personally I have only taken the nest in the plains, the eggs were light blue, unspotted. End of May.

287. **The Striated Marsh-Warbler. Megalurus palustris.**

I never came across this bird actually in the Chin Hills because of lack of suitable country and Harington only records it in the Kachin Hills round Bhamo which is the plains country. In the Shan Hills where rushy swamps are common, this bird makes itself very conspicuous and one cannot help liking its fine song often given on the wing as well as from the top of a bush in the swamp. Both Mackenzie and Hopwood took the eggs of *C. canorus* from the nests of this bird. Nests early May.

288. **The Thick-billed Warbler. Phragmaticola ædon.**

Winter visitors to the Burmese hills. I note it strikes the Shan Hills on migration and remember the species suddenly appearing in the jungle round Maymyo early one May. The birds rested a week or two before going on—three or four birds in a small patch of jungle, singing away like our sedge-warbler and difficult to get sight of. I remember shooting one by getting a friend to do a small drive. Harington used to tell me he was sure it bred in Burma, but he never found the nest that I know of.

289. **Radde's Bush-Warbler. Herbivocula schwarzi.**

A winter visitor ; I notice recorded by Col. Rippon in the Kachin and Shan Hills ; in the latter Cook says it was common.

290. **Tickell's Willow Warbler. Phylloscopus affinis.**

Probably all the Burma Hills.

291. **The Olivaceous Tree-Warbler. Phylloscopus griseolus.**

N. Western Hills.

292. **The Dusky Willow-Warbler. Phylloscopus fuscatus fuscatus.**

This subspecies and *P. f. homeyrei*, Dybowski's Willow-Warbler, probably occur in the Upper Burma hills.

293. **Milne-Edward's Willow-Warbler. Phylloscopus armandii.**

Recorded by Harington as very common in the Kachin Hills. It is probably also a visitor to the Shan Hills.

294. **The Nepal Orange-barred Willow-Warbler. Phylloscopus pulcher.**

Chin, Kachin and Shan Hills. My nests of this bird as recorded in the *Fauna* must, I regret to say, be considered doubtful. It was not near Haka that I got them, the eggs were not speckled but white and the bird I shot off one of the nests was never gathered as it was only wounded and I only saw it and shot the first warbler I saw after. I never got a shot at the actual owner of the other nest.

295. **Pallas's Himalayan Willow-Warbler. Phylloscopus proregulus newtoni.**

The Chin and Kachin Hills.

296. **Forrest's Yunan Willow-Warbler. Phyllosopus proregulus forresti.**

Shan Hills.

297. **The Crowned Willow-Warbler. Phylloscopus humii præmium.**

Winter visitor to these hills.

298. **The Arctic Willow-Warbler. Acanthopneuste borealis borealis.**

Winter visitor to these Upper Burma Hills,

299. **Middendoff's Willow-Warbler. Acanthopneuste nitidus plumbitarsus.**
In the Kachin Hills.

300. **The Annam Willow-Warbler. Acanthopneuste nitidus saturatus.**
A winter visitor to Shan Hills.

301. **The Large-billed Willow-Warbler. Acanthopneuste magnirostris.**
Nothing much recorded of this bird but said to be a winter visitor to Burma.

302. **The Pale-legged Willow-Warbler. Acanthopneuste tenellipes.**
Winter visitor to the Kachin Hills and probably also the Shan Hills.

303. **The Dull Green Willow-Warbler. Acanthopneuste lugubris.**
Winter visitor to all these hills probably.

304. **Temminck's Crowned Willow-Warbler. Acanthopneuste occipitalis coronatus.**
Winter visitor.

305. **Blyth's Crowned Willow-Warbler. Acanthopneuste trochiloides trochiloides.**
This and *A. t. harterti* Baker's Willow-Warbler occur as winter visitors and the subspecies *A. t. davisoni*, the Tennasserim White-tailed Willow-Warbler, breeds in the Burmese Hills—the *Fauna* says 'from Karenni to Tennasserim.' but it was found nesting in the Bhamo and Kachin Hills which are a long way north of the Karen country.

306. **The Allied Flycatcher-Warbler. Seicercus affinis.**
Chin and Kachin Hills.

307. **Anderson's Flycatcher-Warbler. Seicercus burkii tephrocephalus.**
Chin, Kachin and Shan Hills. Breeds in the two former at any rate and it was probably this species I saw building a nest in the Shan Hills. I see Mr. Stuart Baker says these Flycatcher-Warblers have no fear of man, as an instance the above bird building a nest just above my head on the edge of a roadside cutting went on building while I stood within a foot or two of the nest.

308. **The Grey-headed Warbler. Seicercus xanthoschistus xanthoschistus.**
Chin Hills, recorded from Mt. Victoria and I myself took the nest further north at Falam. 19th April eggs a little set. Nest found by bird flying off !

309. **The Chestnut-headed Flycatcher-Warbler. Seicercus castaneoceps castaneoceps.**
Chin, Kachin and Shan Hills.

310. **The Burmese Yellow-bellied Flycatcher-Warbler. Abrornis superciliaris salwinensis.**
Chin, Kachin and Shan Hills.

311. **Sharpe's Flycatcher-Warbler. Abrornis schisticeps ripponi.**
In the Shan Hills.

312. **The Chin Hills Black-faced Flycatcher-Warbler. Abrornis schisticeps flavimentalis.**
Chin Hills.

313. **The White-throated Flycatcher Warbler. Abrornis albogularis albogularis.**
Chin Hills.

314. **The Shan Aberrant Warbler. Neornis flavolivaceus intricatus.**
Chin, Kachin and Shan Hills. Its breeding is recorded in the Kachin Hills, May and June.

315. **The Strong-footed Bush-Warbler. Horornis fortipes fortipes.**
Chin, Kachin and Shan Hills.

316. **Blandford's Bush-Warbler. Horornis pallidipes pallidipes.**
Chin, Kachin and Shan Hills. I was with Osmaston when he found the nest of this bird at Maymyo, east of Mandalay, in the Shan Hills. The eggs were sucked by a cuckoo, unfortunately as they had been left for a full clutch, I must

have spent hours, like Col. Harington, trying to find the nest of this bird, but without success and yet the only one I saw, that mentioned above, it was not a difficult nest to find. Unfortunately later on building drove the birds away from their favourite corner of jungle at Maymyo and I could never discover where they had moved to for their breeding operations. The bird has a very loud unmistakable call.

317. The Rufous-capped Bush-Warbler. Horeites brunnifrons brunnifrons.

Chin Hills.

318. The Yunnan Rufous-capped Bush-Warbler. Horeites brunnifrons umbraticus.

Shan Hills.

319. Swinhœ's Reed-Warbler. Urophlexis squameiceps.

Probably to be found in the Shan Hills.

320. The Golden-headed Warbler. Phyllergates coronatus coronatus.

Chin and Kachin Hills.

321. The Brown Hill-Warbler. Suya crinigera.

The subspecies *assamica* occurs in the Chin Hills. *Yunnanensis*, the Yunnan Brown Hill-Warbler, and *cooki*, Harington's Brown Hill Warbler in the Shan States. I have taken eggs of *assamica* and *cooki* in April and other months during the rains, but May seems the real month. My eggs vary very little, being all of the pink variety with generally a dark ring at the big end. The nests are generally made all of grass and differ from *S. superciliaris* which uses a little moss mixed with the grass.

322. Austen's Hill-Warbler. Suya atrogularis khasiana.

Chin Hills where I found the nest below Mt. Victoria on 1st May. Mackenzie took it much further north at end of April. My eggs are of the greenish ground red-spotted type.

323. Anderson's Hill Warbler. Suya superciliaris superciliaris.

Chin, Kachin and Shan Hills. Quite common at Taunggyi and in that neighbourhood at 4 to 5,000 ft. elevation. Eggs taken are like *S. atrogularis* rather than *crinigera* being smaller and unlike the latter in colouration. But the nests I found were all similar to *S. crinigera* with the exception of the addition of small scraps of moss to the outside. Harington noted this in the nests he found in the Kachin Hills. May is the month in the Shan Hills.

324. The Yellow-bellied Wren-Warbler. Prinia flaviventris flaviventris.

Apparently to be found in all the Upper Burma Hills in suitable localities but I never came across it in the hills, and Harington in recording from the Kachin country says it occurs on the plains round Bhamo.

325. The Burmese Wren-Warbler. Prinia inornata burmanica.

We seem now to be fairly certain of the races of these species and *burmanica* seems the only one inhabiting these Upper Burma Hills. They do not go much above 3,000 ft. I think in the Shan Hills they breed much earlier than they do in the plains where June seems about the height of the season. I should have said the nests were generally purse shaped. I think one would be right in asserting this species must have water near it either in the form of rivers or a lake. *Prinia* seems to go mad in the breeding season and makes extraordinary contortions in the air. The tail taking charge of the fusilage!

XVII.—Family REGULIDÆ

326. The Yunnan Goldcrest. Regulus regulus yunnanensis.

Apparently our only goldcrest from the Northern Shan Hills. I do not know the place quoted in the *Fauna*. Our hills are not as a rule high enough for this race, I suppose, or they may have escaped observation in the Chin and Kachin Hills.

(*To be continued*)

SHELLS
OF THE TROPICAL SEAS

BY

IDA COLTHURST

PART III

(*With two plates and one text figure*)

(*Concluded from page 564 of this volume.*)

THE CONCHIFERA

The *Conchifera*, from *concha* a shell and *fero* I bear, are better known as *Bivalves*, and form a vast family very difficult to determine into well-defined groups. Many are sedentary only having a short free-swimming youth, after which they either bury themselves or anchor to some stone, rock or foreign substance. They have no definite head, many are without eyes and the foot is frequently rudimentary because of their limited powers of locomotion. The burrowers, however, have a thick, fleshy foot which is thrust down into the sand, and then with either a little jerk or a half-rotary motion a portion of the shell sinks and the action is repeated until the animal descends to a depth convenient for the extension and protrusion of the respiratory tubes; in some, the fringed mouths lie on the surface of the sand and can only be discerned by tiny swirls and squirts, which are the currents of water they are attracting and repelling, a process adopted for the purpose of filtering all nutrimental and shell-producing matter and then rejecting the effete water; others accomplish the same thing by means of opening and shutting their shells and by a continual movement of the *Cilia*. All are enclosed in a pair of shells united by a hinge, in a few of which the spiral tendency is evident. Some live in a vertical position as regards the planes of the valves, others lie on one or the other side, in which case the lower shell is deeper than the upper one. The apex, that is where shell growth commenced, is called the *Umbo* in bivalves, and here, the leaves are united by a hinge-band of horny fibre called *Chitin*, and by interlocking teeth. By the elasticity of this attachment and the action of certain muscles the valves are opened and shut. In most *Bivalves* this muscle adjustment and the mantle line are evident on the interior surfaces of the shells; the latter is known as the *Pallial line*, and where it is observed not to run in a continuous curve but to form a bay, that is, a sharp bend inwards, it indicates that the animal had retractile breathing tubes.

The best-known of the *Bivalves* are the *Oysters*. They frequently have the valves unequal, the upper flat, the lower slightly convex. The shells increase in size first by adding new marginal rings, then by growing thicker. There are a great many kinds of oysters, and although they have been preyed upon by man and other animals for ages, yet their numbers appear to be legion. One of their worst enemies is the Star-fish.

> ' The prickly Star keeps on with full deceit
> To force the Oyster from his close retreat ;'
>
> JONES' OPPIAN.

Tritons also bore into their shells, making a cleanly cut, perfectly round hole. Oysters are very intolerant of cold and thrive in warm seas ; from very ancient times India has been famous for her oysters and has been regarded as the chief market of the world for the best pearls, the fisheries at Ceylon being the largest. Another great centre is the Island of Bahrein in the Persian Gulf, and on the West Coast the trade is prosecuted at various places, Nawangar in the Gulf of Cutch, at Ratnagari, and about twenty years ago there was considerable excitement over some pearls found at Belapur in the Thana Creek, Bombay.[1]

The most valuable pearls are produced by the *Margaritifera* ; at one time they were believed to be caused by a worm, the larva of a Cestode, which occasioned the oft-repeated French epigram that ' A pearl is the glittering sarcophagus of a worm '! Now, however, they are known to be due to a pathological process brought about by the introduction of some irritating substance, like a grain of sand, into the mantle. The Chinese, always with an eye to the main chance, profit by this fact and introduce between the valves little scraps of mother-of-pearl, or tiny images of Buddha attached to wires, which they remove when coated with nacre. Similar concretions of various colours surrounding a foreign body are found in porcellaneous shells and are used as beads. Oysters cast their spawn or *spats*, as they are called, upon rocks, shells, etc. to which they immediately adhere : they look exactly like drops of greenish tallow, but soon a tiny transparent shell appears provided with a fringe of hair-like processes or *Cilia*, with which the baby oyster can paddle in the water.

Scallops, genus *Pecten*, are fan-shaped and the valves are flat and usually decorated with radiating ribs. The older Scallops moor themselves by a *byssus*, but when young they are very active and swim by rapidly closing and opening their valves ; when the sea is calm they move about in little fleets, the yawning of the shells disclosing their many eyes which lie on the edge of the mantle and shine most brilliantly. One of the family *Pecten jacobeus*, St. James' Shell, in ancient times was the badge of the pilgrim to the Holy Land

> ' Who quit his cell ; his pilgrim staff he bore,
> And fixed the Scallop in his hat before '!

The flat, white, round and beautifully translucent shells of the Window Oyster, *Placuna placenta* are a very common object on our shores. They are exactly like discs of mica, quite smooth and delicately lined, young ones being tinged with pink. In China, cut into squares of two inches and secured between light strips of wood, they are used as window panes. Hornell says, that the Portuguese borrowed the idea and introduced the use into India in the sixteenth century, and that even to-day the windows of old houses in Goa and Diu and the Governor's Palace at Marmugoa, have many windows glazed in this peculiar way. Sometimes tiny seed pearls are enclosed in the valves which are not of much value, but are calcined in crucibles and used by wealthy Indians as lime with betel and *pan*; also they are burnt to form the black powder so sought after to beautify and strengthen the eyes of children and are placed in the mouths of the rich dead at cremation; and, from very ancient times, boiled with the juice of certain flowers and leaves and reduced to a powder with burnt coral, they are administered in tuberculosis and other wasting diseases.

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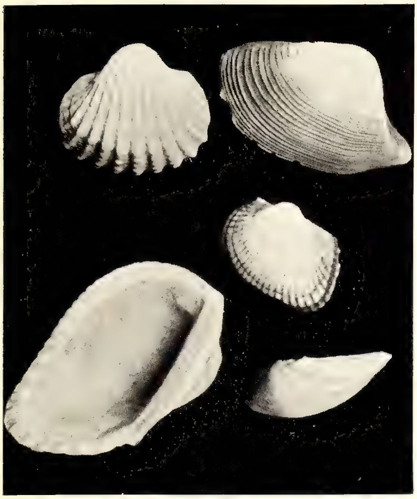
[1] These were seed pearls obtained from the Window-pane Oyster (*Placuna placenta*). A small industry in these pearls is still carried on.—*Eds.*

The Mussels, *Mytilidæ*, are wonderfully prolific and the greatest enemies of oysters, settling down over a bed and simply smothering them; their shell is wedge-shaped and they moor themselves, by means of a strong, silky *byssus* or line which they spin, to piles, stones, etc. Though not so highly esteemed as the oyster, the mussel is edible and on the West Coast from Karachi to the Cape, *M. smaragdinus* is eaten and is considered by fishermen and low caste Hindus an excellent shell-fish, though at certain seasons it is unsafe, as partaking of it causes nausea and a skin eruption. In some places man has put mussels to an extraordinary use; being aware of the inefficacy of the tide to dislodge them because of their strong anchorage, they are employed in boatloads to fill in all interstices of a bridge where the tide runs so rapidly that repair cannot be effected in the usual way with mortar. This was the case at Bideford in North Devon, where, at the junction of the Taw and Torridge rivers a long bridge of 24 arches was difficult to repair ordinarily because of the swift currents, and many boatloads of mussel were regularly imported by the Town Council for such work. Many of the Mussels have a tiny crab living with them under the shell as a

Dark shell—Scallop; others Cockles, common in Bombay



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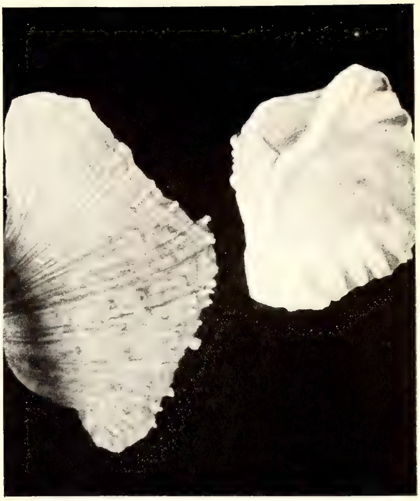

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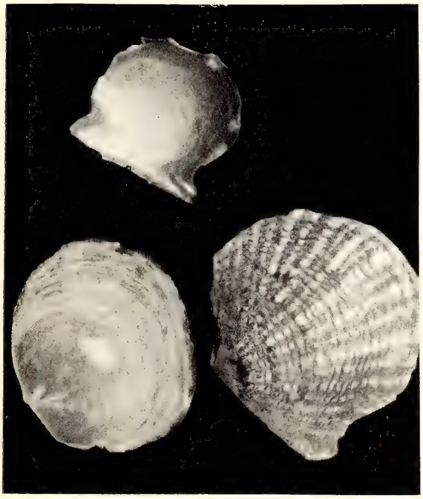

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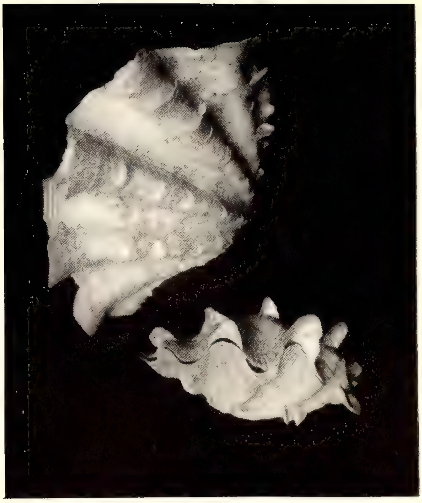

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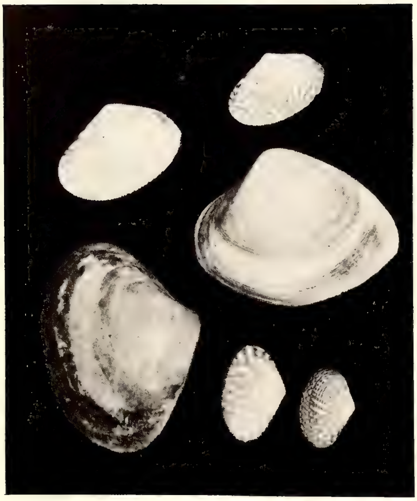
1. Left above : Cockle (*Cardiadæ*) ; Right : Wedge Shell (*D. scrotum*) ; Middle : Arc Shells.
2. The Spotted Bear's Paw (*Hippopus*).
3. Left : Window Oyster (*Placuna placenta*) ; Right and above : Pearl Oyster (*Margaritifera*).
4. The Giant Clam (*Tridacna*).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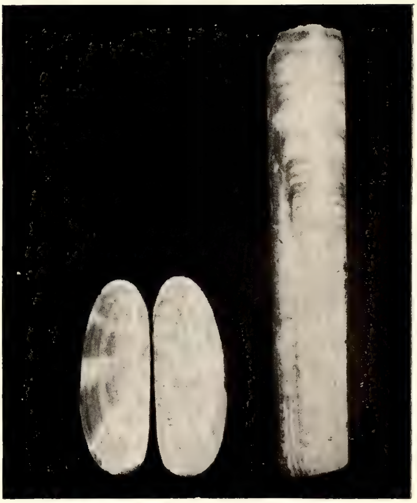
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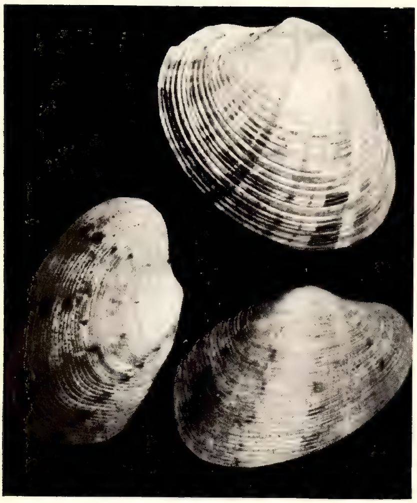
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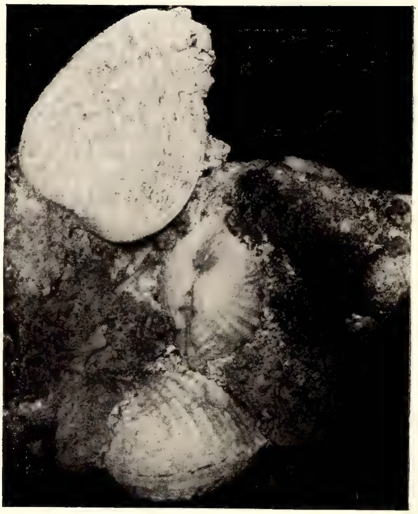
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1. Venus Shells. Large one on right: *Chione pinguis* ; Large one on left: *C. radiata* ; Small ones: *Meröe*.
2. Left: The Sunset Shell (*Psammobia*) ; Right: The Razor Shell (*Solenidæ*).
3. Cytherea.
4. Angel's Wings. (*Pholas* buried in stone.)

mess-mate, which the older naturalists believed warned it when danger threatened, by nipping the mantle.

Lima indica, found off the Travancore coast, gives home to *Pinnoteres abyssicola*, a wee crab.

The Arc shells *Arcadæ* are thick, with a long, straight hinge-line, distinctly humpy and generally found covered with a rough epidermis. The inmates are exceedingly retiring and hide away under stones and in the crevices of rocks. The West Coast is rich in the species. *A. bistrigata*, a rough, oblong, lime-covered shell fastens itself to rocks, etc. by a strong, horny *byssus* and is most difficult to remove. *A. inæquivalvis*, is very thick and broadly ribbed, and as its name implies, has uneven valves; *A. japonica* is of a glistening white; *A. granosa* like an equilateral triangle with 20 ribs. *A. lactea* very humped, small and yellowish, forms a part of the shore shingle at Bombay and on all coasts. At the north end of the Bay of Bengal a lovely little *Arca* is found which has the lustre of mother-of-pearl when the outer epidermis is removed, called *Nucula fultoni*.

Tridacna or the Giant clam is found in the Laccadive Sea and in lagoons of coral fields. The shell is thick, strongly ribbed, sometimes also furnished with squamous plates, and very heavy, often attaining great size as it grows older. One weighing five hundred pounds had an animal of twenty pounds. They moor themselves by a powerful *byssus* and Darwin believed the shell muscles to be so strong that if a man were to insert his hand between the valves he would have to leave it in the tremendous grip until the death of the creature. Old mythological pictures show Venus emerging from the sea riding in a pair of the opening valves and to this day the dead shells are used in churches as *bênetiers* for holding holy water. At St. Sulpice in Paris, a pair two feet across presented by the Venetian Republic to Francis I, are still in use; these, however, are exceeded by a pair three feet wide at the British Museum.

The *Hippopus* or Spotted Bear's Paw is also a large shell, but not anything of such gigantic proportions. It is found near coral reefs and is radially rayed and crimped.

The *Cardiadæ* or Cockles, are free, that is they never moor themselves to objects: the valves are strongly ribbed and have a waved margin. The animal, living in sandy places in low water, is largely used for food and sometimes occurs in immense beds. *C. asiaticum*, pale yellow and deeply ridged is found on our shores: the double shell viewed sideways clearly demonstrates how the species have obtained their specific name. *Lucniacea antiquata* too is very common: the valves are almost circular and their surface is dull, white with irregular blotches and streaks of rusty brown. All round the coasts of India these shells, which are very gregarious, are extensively burnt for making lime, known as *sipika-chuna*, which however contains little cementing property and is only employed in white-washing. In South India, however, lately they have successfully mixed it with laterite to form a Portland Cement.

The Venus Shells are also free, living deep-burrowed in sandy or muddy sea bottoms. The shell, oval or almost circular in shape, is often very beautiful in its colour and markings. *Chione pinguis* is common in India: it is very shining and smooth, rather thin and in colour a light or dark grey with concentric lines. Very like it is *C. radiata* but the colour is a mottled grey, sometimes reddish. *Tapes textrix* is ovate, oblong, very shining and yellowish marked with a black network of zig-zag patterns. *Meröe effosa* is concentrically lined and nearly covered with bold angular markings. And the tiny ribbed bivalve shells, white, yellow or faintly purple which comprise so large a part of the shingle are *Venus imbricata.* *Artemis* is nearly circular, and immediately under the beak a small heart-shaped indentation can be discerned, which is largest in *A. gibba* a very thin shell, much swollen near the beak.

Donax or Wedge shells are inequilateral and the posterior valve, on which it lies, is truncated. *D. scortum* is found all round our coasts: it is sharply shortened, is concentrically striated forming ridges anteriorly, brownish grey on the outer surface and a polished violet on the inner. *D. incarnatus*, a pretty pink or purple tinged smooth little shell, is plentiful in the shingle.

The *Cytherea* are elegantly sculptured with transverse ribs and darker rays passing from beak to margin. They are called after a classical name of the Goddess Venus who loved the island of Cytherea.

The *Tellinidæ* have equal valves richly coloured and marked, very flat and closely compressed. They are found in sandy places burrowing beneath the surface, and are largely represented in Indian Seas. The Sunset Shell, *Psammobia* is purple, thin, almost transparent and oblong with whitish rays passing from beak to margin. *T. truncata* is thinner, very smooth and pure white, but very inequilateral. T. *emarginata* has the posterior side scooped, and is pinkish and very polished.

The *Solenidae* or Razor Shells are long, either straight or slightly curved, of a transparent browny-purple with tranverse and longitudinal bands in a darker or lighter tone; they are so called because of their fancied resemblance to a razor. The mollusc always lives buried in the sand in an upright position as it is quite incapable of progression: its strong cylindrical foot pushes its way down with amazing dexterity, leaving on the surface a little double aperture like the figure 8 which is the position of the two siphon tubes and from which spirt up little jets of water. Notwithstanding the fact that the natural habitat of Razor Shells is salt water, they have a remarkable dislike for salt and can always be made to jerk right up above the surface by dropping a few grains where their water jets appear. However, if once they are taken up and put down again no amount of salt will induce them to reappear.

Angel's Wings, *Pholas*, also lives perpendicularly, but buried in spongy rock or wood. The shells are equal, white, rather thin and brittle and gape at either end, faintly resembling wings of cherubim; when young they penetrate the rock, both foot and shell helping in working their way, moving the body first to one side and then to the other, inwards of the rock and finally downwards, exactly as a carpenter employs a broad awl; as they grow in size, they enlarge their burrows, affording a most wonderful instance of perseverance and patience, and attaining with a soft fleshy instrument what stronger animals find impossible to accomplish ; there it lies for life, at ease in a dark sepulchre, content to find sufficient nutriment in the sea water which trickles through the aperture of its tunnel, truly fortunate in having learnt to 'Translate the stubbornness of fortune into so quiet and so sweet a style.' !

INDIAN DRAGONFLIES

BY

F. C. FRASER, LT.-COL., I.M.S., F.E.S.

Part XXXIV

(*With two plates and four Text-figures*).

(*Continued from page 597 of Volume XXXIII*).

Family CŒNAGRIONIDÆ.

(= Family *Agrionidæ* Selys, and Subfamily *Cœnagrioninæ* Kirb.)

Dragonflies of small or medium size with characters of the suborder *Zygoptera* of which they form by far the largest division.

Wings very narrow and of equal size and shape, the base of hind not more dilated than the fore, all four markedly petiolate, venation very simple especially at base of wings, only two antenodal nervures, discoidal cell entire, elongate, squared or acutely pointed distad, often differing slightly in shape in the fore- and hind-wings, arc situated about midway between base of wing and node or nearer node than base. Abdomen long and attenuated.

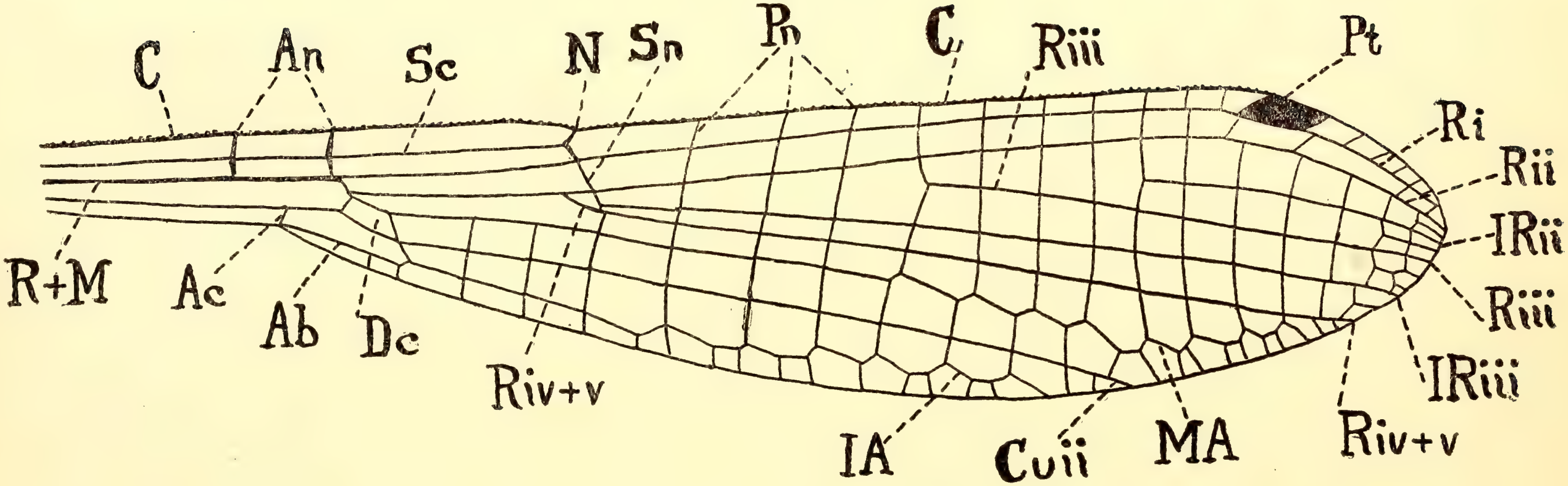
Larvæ elongate, cylindrical, breathing by means of caudal gills, all active swimmers living usually in weed. Breeding in still and running water.

Distribution. Cosmopolitan. The Indian fauna is a very rich one and belongs to seven subfamilies of which the *Cœnagrioninae* form the greatest bulk.

KEY TO THE SUBFAMILIES OF THE *Cœnagrionidæ*

1.	The nervure *IA* absent and *Cuii* markedly reduced	*Platystictinæ.*
	The nervure *IA* present, *Cuii* of normal length or reduced	2
2.	No intercalated sectors at apical end of wing ...	3
	A variable number of intercalated sectors at apical end of wing	4
3.	Cells of wings mostly four-sided ; discoidal cell with costal side about one-fifth shorter than lower side and with outer angle sub-acute ...	*Platycneminæ.*
	Cells of wings mostly four-sided ; discoidal cell with costal side of the same length as lower and with outer end of cell squared, not angulate ...	***Protoneurinæ.***
	Cells of wings mostly five-sided ; discoidal cell with costal side much shorter than lower and with outer end acutely angulate	*Cœnagrioninæ.*
4.	*Riv* + *v* and *IRiii* taking origin closer to node than arc ; oblique vein absent ; distal end of discoidal cell sub-acute or blunt	*Megapodagrioninæ.*
	Riv + *v* and *IRiii* taking origin closer to arc than node ; an oblique vein present between *Riii* and *IRiii* about halfway between node and pterostigma ; distal end of discoidal cell very acute...	4
5.	*Cuii* at its origin from discoidal cell strongly arched towards the costa ; moderately large species	*Synlestinæ.*
	Cuii at its origin only slightly arched towards the costa ; rather small species	*Lestinæ.*

INDIAN DRAGONFLIES


C
An
Sc
N
Sn
Pn
C
Riii
Pt
Ri
Rii
IRii
Riii
IRiii
Riv+v
MA
Cuii
IA
Riv+v
Dc
Ab
Ac
R+M

WING OF CŒNAGRIONID SHOWING THE NOTATION USED IN THE TEXT

Subfamily SYNLESTINÆ Tillyard, (1917)

Synlestinæ, Tillyard, 'Biology of Dragonflies', p. 277 (1917); Laid. Rec. Ind. Mus., vol. xix, p. 187 (1920).

Dragonflies of medium size, considerably larger than the average Cœnagrionid, usually with green metallic head and body; resting with wings wide spread. Wings with a long petiole, hyaline or barred with blackish brown, discoidal cell elongate, narrow, acutely angulated distad; sectors of arc arising just a little above middle of arc; *Riii* arising from *Rii* far distad of node; *Riv+v* arising from *Rs* at or a little proximad of the subnode; *Cuii* arched strongly costalwards at its origin; *Riv+v* and *IRiii*, except in genus *Megalestes*, arising closer to node than to arc and closely converged at their distal ends; an oblique vein present or absent between *Riii* and *IRiii* at about midway between node and pterostigma; pterostigma variable, usually elongate; intercalated sectors at apical end of wings usually present: anal bridge (*ab*) very short but well developed in the Indian genera; anal field small. Abdomen very long and slim. Superior anal appendages of male forcipate, spined outwardly.

Larva. Long slender; pedicel of antennæ much elongated; caudal gills lamellate, lanceolate, oar-shaped; mask long, median lobe deeply and narrowly cleft, lateral lobes without setæ, with short robust movable hook, two apical robust teeth, and the biting border minutely dentate. Legs long and spider-like. Gizzard with a few robust teeth on each fold. Breeding in streams in montane or submontane areas.

Distribution. Only two genera known from within Indian limits, viz. *Megalestes* Selys and *Orolestes* MacLach. This subfamily is represented in Australasia by *Synlestes*, in Africa by *Chlorolestes*, in Asia by the two Indian genera mentioned above.

Genus MEGALESTES Selys (1852).

Megalestes Selys, Bull. Acad. Belg. (2) vol. xiii, p. 293 (1862); Kirby, Cat. Odon. p. 159 (1890); Laid. Rec. Ind. Mus. vol. xix, pp. 186, 187 (1920).

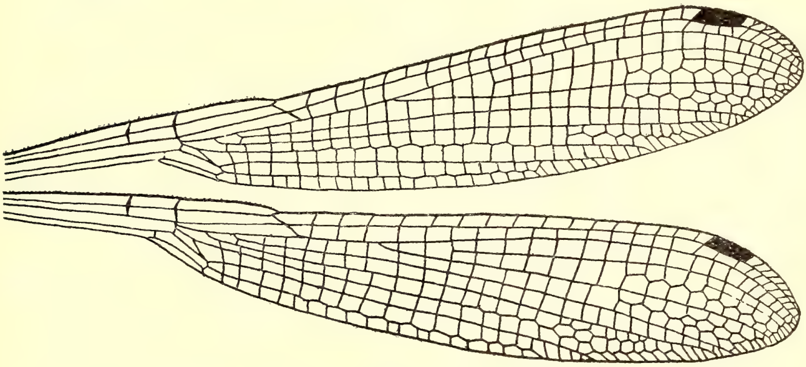


FIG. 1. Wings of *Megalestes major*, Selys

Comparatively large Cœnagrionids with vivid metallic green body marked with pale yellow and abdomen of great length. Wings long and narrow; pterostigma elongate, nearly three times as long as broad, broader at middle than either end, braced; postnodal nervures numerous; arc situated at the distal antenodal nervure; postcostal nervure (*ac*), arising much nearer the distal antenodal nervure and petiolation of wings ceasing some distance before its junction with the anal bridge (*ab*), this point slightly distad of the level of the midpoint between the two antenodals in the forewing, and well distad of that point in the hind; discoidal cells very acutely pointed distad, the costal side not quite double the length of the basal in the forewing, and slightly more than double in the hind; *IRiii* and *Riv+v* arising much closer to arc than node and running parallel to each other for some distance; oblique vein usually present between *Riii* and *IRiii*; *Riii* arising from *Rii* much nearer node than pterostigma; 3 or 4 intercalated sectors at the apical ends of wings.

Abdomen very long and slender, much longer than the wings; legs moderately long, hind femora extending to hinder end of thorax and armed with 10 to 12 robust spines; tibiæ with longer finer spines; tarsal claw-hooks robust, situated at end of claws. Anal superior appendages forcipate; inferior short rounded. Female with robust ovipositor, abdomen considerably shorter and stouter than in male.

Distribution. N. E. India, Nepal, Sikkim, Burma, Indo-China and S. China. Genotype, *M. major*, Selys.

Megalestes major, Selys (1862).

Megalestes major Selys, Bull. Acad. Belg. (3) vol. xiii, p. 293 (1862); Kirby, Cat. Odon. p. 159 (1890); Needham, Proc. U. S. Nat. Mus., vol. xxvi, Pl. li, fig. 7 (1903); Laid. Rec. Ind. Mus., vol. xix, pp. 148 and 185–187 (1920).

Male. Abdomen 48–54 mm. Hindwing 33–36 mm.

Head; labium yellow; labrum brilliant metallic emerald green; bases of mandibles bright citron yellow; anteclypeus black; postclypeus, frons and vertex glossy metallic emerald green with a royal blue reflex when viewed from certain angles; occiput and whole of area behind ocelli and eyes dull metallic green with a coppery reflex; eyes dark brown; antennæ black.

Prothorax dull metallic emerald green pruinosed to white in adults at sides and middorsum; posterior lobe dull black, with a medial spot of yellow in tenerals.

Thorax brilliant glossy metallic emerald green on dorsum, antealar sinus and laterally as far as the postero-lateral suture; middorsal suture and lateral suture finely black as also a narrow stripe along the anterior border of metepimeron, posterior to which the rest of metepimeron bright yellow. The lower portion of midlateral suture also narrowly yellow, this colour broadening out below over trochanter. Beneath entirely light yellow with the lower part of sides and whole of beneath, in adults, pruinosed white so as to obscure the ground colour.

Legs bright yellow as seen from behind, dull black or enfumed when viewed from the front; spines and tarsi black.

Wings hyaline, uncoloured or palely enfumed especially at apices; pterostigma variably yellow to brown in tenerals, black in adults, covering 2½ to 3½ cells, strongly braced; 16 to 21 postnodal nervures in forewings, 15 to 16 in the hind; other items of venation as for genus.

Abdomen dull metallic green on dorsum and sides, more brilliantly metallic on segments 1 and 2; the sides of segments 1 and 2 and base of 3 pale yellow; intersegmental joints narrowly black as well as beneath; dorsum of segments 9 and 10 pruinosed white in adults.

Anal appendages black; superiors slightly longer than segment 10, forcipate, the apices meeting or even overlapping, broad at base where, on the inner side, is seen a short robust quadrate process after which the appendix is slightly tapered and strongly twisted on its long axis so that the outer side comes to look rather upward; a robust spine on the inner side at junction of apical and medial thirds. Inferior appendages rudimentary rounded and with a moderately robust short spine directed upwards and analwards.

Female. Abdomen 45–47 mm. Hindwing 36–35 mm.

Very similar to the male but of more robust build and with a shorter stouter abdomen. A specimen from Assam differs as follows:—Prothorax with the whole of posterior lobe and a large triangular middorsal spot bright chrome yellow; antealar sinus with a spot of yellow on each side, variable in size; the whole of metepimeron except for a short upper anterior spot of metallic green, bright chrome yellow, as also a broad wedge-shaped stripe on midlateral suture broadening below. Hinder pair of femora all yellow save for the distal ends which are enfumed brownish black; wings rather broader; 18 postnodals in forewings and 16 to 17 in the hind; pterostigma dark reddish brown. Abdomen with the yellow markings more extensive, the sides of segment 1 broadly, the whole ventral border of segment 2, a narrow basal ring to segment 3, repeated, but obscurely so on segments 4 to 7, the ventral border of segment 8 and a ventro-lateral spot on segment 9, whilst segment 10 has the greater part of the dorsum yellow, the middorsal carina, a subdorsal spot on each side confluent with an apical border alone being blackish metallic green. In a specimen from Dehra Dun the dorsum of segment 10 is thinly pruinosed, partially obscuring the markings, the whole of the dorsum of this segment dull metallic green, whilst the whole of the sides are yellow ; segment 9 has a small baso-lateral and a large apico-lateral spot of yellow ; the ground colour of the abdomen in this specimen being coppery metallic.

Anal appendages moderately short, about three-fourths the length of segment 10 in the Assam material, and about half the length of that segment in the specimen from Dehra Dun, short pointed conical, widely separated, black. Ovipositor dark blackish brown with a spot of yellow variably present laterally, very robust, extending to end of abdomen.

Distribution:. Assam, Bengal, Sikkim, Nepal and the North Punjab Hills up to an altitude of about 8,000 ft. The specimens reported by Martin from Tonkin are a distinct race or even species and not *M. major*. Dehra Dun 26. IX., Shillong and Mawphlang, Assam, 10. X., Mangpoo, Darjeeling District 3,000 ft., 18. V. and 12 VII, Muktesar, Kumaon Hills, 7,000 ft.. 9. V., Kakani Nepal, 7,000 ft., 18. VII.

I found the larva, which has been described by Dr. Laidlaw, l. c.,in a sandy and gravelly stream at Ghoom near Darjeeling, 8,000 ft., in the month of May, the water then being icy cold at that elevation, but the larva, nevertheless, full-grown. Lower down the hill slopes, at about 6,000 ft., in a scrub jungle and hillside marsh, I found tenerals emerging from small brooklets which formed a network throughout the marsh.

Mr. T. Bainbrigge Fletcher has sent me the following notes on the occurrence of this species in Shillong :—' Moderately common amongst bushes below Kenilworth 5,000 ft. during the second half of August, 2 or 3 seen daily. Always solitary although 2 or more may be seen in one locality, generally 100 yards up and down stream and about 20 yards from the stream, never more, and on bushes. Slow unsustained flight, settling with wings half expanded. None seen in crop. Specimens seen right up to the 20th October.' Similar habits were observed by myself near Darjeeling, tenerals hiding up in dark jungle in company with *Caliphæa confusa.*

Megalestes irma, Fraser (1926).

Megalestes irma, Fras. Journ. Darjeeling Nat. Hist. Soc., pp. 32, 33 (1926).

Male. Abdomen 60-65 mm. Hindwing 36-37 mm.

Head : labium yellow ; labrum glossy metallic emerald green ; bases of mandibles bright yellow, the upper apical half glossy black ; anteclypeus yellow marked with two submedial blackish spots inclining to metallic ; postclypeus, frons and vertex glossy metallic emerald green with a peacock blue reflex in certain lights ; rest of head dull metallic green ; eyes brown ; antennæ black.

Prothorax dull black with two large rounded bosses and the middorsum dull metallic green, and the whole of the posterior lobe, except the extreme base which is black, bright yellow ; the lower part of the sides also yellow.

Thorax brilliant emerald green on dorsum and sides as far back as the hinder suture, the sutures finely black, a narrow medial stripe on each side of the mesepimeron bright chrome yellow as also the whole of metepimeron except for a narrow irregular stripe of metallic green along its anterior border. *Beneath black*, pruinosed white. *Legs wholly black* except the trochanters and coxæ of the anterior pair which are yellow.

Wings hyaline, uncoloured ; pterostigma reddish brown, strongly braced, covering 2 to 3 cells ; postnodal nervures to forewings 18-24, hindwings 17-18 ; *ac* and *ab* in the hindwing meeting at hinder border of wing, petiolation ending however before *ac* in the forewings.

Abdomen much longer than in *M. major* and nearly twice the length of wings in some specimens, dull black with a dull metallic reflex green or coppery ; segments 1 and 2 brighter glossier metallic green and rather broadly yellow on lower part of sides ; segments 9 and 10 pruinosed white on dorsum.

Anal appendages black, differing markedly from those of *M. major*. Superiors as long as segment 10, forcipate, strongly curved in to meet at apices, outer borders unspined ; no vestige of an inner medial spine as in *M. major* ; base thickened and with an inner blunt but prominent tongue-like spine somewhat similar to that seen in *M. major* but longer, curled inwards and downwards and tipped with yellow. Inferiors differing still more, short rounded tumid masses with two strongly imbricated spines, one short and robust on the outer side shaped like a rose thorn ; the second springing from the apex below, very long and curling strongly upwards like the horn of a goat.

Female. Abdomen 51 mm. Hindwing 37 mm.

Similar to the male but with shorter and more robust abdomen. Yellow on abdomen more extensive, obscure basal rings on segments 3 to 6, and a ventro-lateral stripe on segments 8 and 9. Anal appendages short, black, conical pointed. Ovipositor robust, extending to end of abdomen, blackish brown.

Distribution. Sikkim.

Differs in many respects from *M. major*, viz. by the black spot on bases of mandibles ; by the great length of abdomen ; by the greater number of postnodal nervures ; by the black legs and black under surface of thorax (which latter forms an easy method for identification), and lastly by the entirely different character of the appendages, especially the inferiors which bear two spines instead of only one.

Type male and female in the Darjeeling collection, paratype males in the Fraser collection, one of which goes to the British Museum. All specimens collected by Mr. Chas. M. Inglis at Gangtok 5,000 to 6,000 ft, Sikkim, 29. v. 24 near the source of the Rani Khole river.

Genus OROLESTES MacLach (1895).

Orolestes MacLach., Ann. Mag. Nat. Hist. (6) vol. xvi, p. 21 (1895) ; Laid Rec. Ind. Mus. vol. xix, pp. 146, 148 and 186 (1920) ; Needham, Ent. News, vol. xxii, pp. 342–344, pl. xi figs. 1–4 (1911) ; Munz, Mem. Amer. Ent. Soc. No. 3, p. 48 (1919).

Moderately large Cœnagrionids with wings partly coloured and opaque black ; body non-metallic and abdomen of great length. Wings long narrow, largely opaque blackish brown ; pterostigma elongate, more than four times as long as broad, dilated at the middlle, braced ; postnodal nervures numerous ; arc situated at the level of distal antenodal nervure ; postcostal nervure (*ac*) situated much nearer the distal antenodal nervure and petiolation ceasing at its level, that is *ac* meets *ab* at the hinder margin of wing ; discoidal cell broad, markedly acute distad, its hinder border longer than costal and thrice as long as the base ; *IRiii* and *Riv + v.* arising much closer to arc than to node and running parallel to each other for some distance ; oblique vein usually present between *Riii* and *IRiii ; Riii* arising from *Rii* 8 cells after the node in forewings and 7 cells after in the hind ; only 2 intercalated sectors at apical end of wings, between *Riii* and *Riv + v.* Abdomen slender, long, much more so than wings ; legs moderately long, hind femora extending to hinder end of thorax, spines of moderate length and similar to those of *Megalestes ;* anal appendages very long, forcipate, inferiors short, triangular, without spines.

Distribution. N. W. India, Darjeeling district. (Female unknown.)

Genotype—*O. selvsi* MacLach.

Orolestes selysi MacLach. (1895).

Orolestes selysi MacLach. Ann. Mag. Nat. Hist. (6) vol. xvi, pp. 21–23 (1895) ; Mart. Mission Pavie, p. 18 (1911) ; Laid. Rec. Ind. Mus. vol. xix, pp. 148–150 and 186 (1920).

Male. Adbomen 57 mm. Hindwing 36–39 mm.

Head : labium yellow ; labrum olivaceous green, as also the bases of mandibles ; rest of head black except the back of occiput and eyes which are yellowish ; eyes brown.

Prothorax olivaceous green clouded on the middorsum ; posterior lobe simple, rounded.

Thorax bronzed green on dorsum as far out as the hinder margin of humeral suture ; an ill defined stripe pale olivaceous on either side of middorsal carina ; the sides pale olivaceous green or yellow with a trace of the dark bronzed green on upper part of midlateral suture.

Legs black, femora yellowish brown on flexor surface.

Wings hyaline at base and apex, blackish brown between these two points with a steely blue reflex, this broad fascia with an oblique border proximad and a straight slightly irregular border distad where it ends about one cell proximad of the pterostigma and is edged narrowly with a milky opalescent white border; the cell-middles in the dark area paler ; reticulation black ; pterostigma dark brown between thick black nervures, 3·5 mm. in length ; 21–24 postnodal nervures in forewing, 19–20 in the hind.

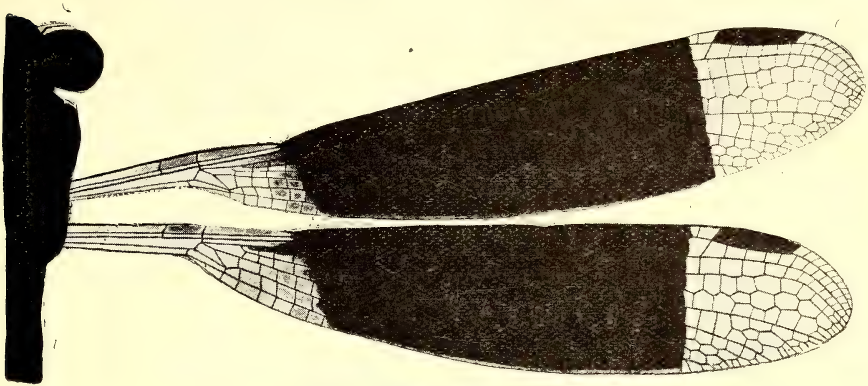


FIG 2. Wings of *Orolestes selysi* MacLach.

Abdomen bronzed green on dorsum of segments 1 and 2, bronzed black on the remainder but segments 3 and 4 with a medial bluish area and ringed with black at either end ; segments 1 and 2 broadly olivaceous green laterally, narrowly so on segments 3 to 5 and basal half of 6 ; margins of segments 7 to 9 minutely spined apicad ; segment 10 slightly notched.

Anal appendages black, the inferiors tipped with yellow ; superiors half as long again as segment 10, slender, regularly curved and forcipate so that the apices meet or overlap ; outer border finely spined along apical half ; a robust basal tooth on inner side and a dilatation, which extends along inner border nearly to apex and ends in a broad triangular acute tooth ; apices rounded, blunt. Inferiors barely half the length of superiors, broad, triangular with inner borders straight and closely apposed.

Distribution. Darjeeling District. Two males in the MacLachlan collection in rather poor condition, the dark fascia in one being much paler than in the other from the teneral condition of the specimen. The species must be either very rare or very local as Mr. Chas. Inglis has not so far rediscovered it, although all other of the Selysian species from that area have fallen to his net ; it is quite easily recognized from all other Indian Lestids by its coloured wings, these being hyaline and uncoloured in all others save for some slight or occasional enfumation.

SUBFAMILY LESTINÆ.

Dragonflies of small size with metallic or non-metallic markings on head, body and abdomen ; resting with wings nearly wide open, or more rarely with the wings closely apposed over the dorsum.

Wings hyaline, uncoloured except for occasional enfumation ; with a long petiole, petiolation begins at the postcostal nervure (*ac*) about midway between the two antenodal nervures, *ac* meeting *ab* at the hinder border of wing ; discoidal cell elongate, narrow, similar or differing in the fore and hind-wings, very acutely angulated at the distal end ; sectors of arc arising from middle of arc ; *Riii* arising from *Rii* well distad of the node ; *Cuii* only but slightly arched or not at all at its origin ; *Riv* + *v*. and *IRiii* arising much nearer arc than node and far proximal of the subnode ; an oblique vein always present between *Riii* and *IRiii* at about midway between node and pterostigma; pterostigma variable, nearly always at least twice as long as wide, often more so ; intercalated sectors usually present at apical end of wings ; anal bridge (*ab*) always present and well developed ; anal field small.

Abdomen long and slender ; superior anal appendages of male forcipate spined outwardly ; inferior appendages variable.

Larva long, slender, abdomen cylindrical; caudal gills long rounded at apex, paddle-shaped, secondary trachea arising at right angles to the main stems; mask with the lateral lobe greatly expanded, concave; deeply and irregularly toothed; setæ on middle lobe and movable hook usually to the number of 5 and 6 respectively; middle lobe simple, not fissured, movable hook of great length; gizzard with 8 folds, 4 major and 4 minor, the former with a specialized dentition of 3 to 5 very large teeth and numerous smaller ones; antennæ with elongate pedecil. Breeding in tanks and ponds, rarely if ever in running water.

Distribution. Cosmopolitan. Five genera known from within Indian limits,—*Lestes*, Leach, *Platylestes* Ramb, *Indolestes* Fraser, *Ceylonolestes* Kennedy, and *Sympycna* Charp.

Key to Genera.

1.	Pterostigma nearly as broad as long, nearly squared	*Platylestes.*
	Pterostigma at least twice as long as broad, usually more so	2
2.	Discoidal cell of hindwing longer and much narrower than that of forewing... ...	3
	Discoidal cell of hindwing shaped similarly to that of forewing	*Lestes.*
3.	Posterior lobe of prothorax trilobed, the middle lobe projecting far beyond the laterals; *ac* almost at the level of the basal antenodal nervure; palaearctic species ...	*Sympycna* Charp.
	Posterior lobe of prothorax a single simple lobe uniformly arched; *ac* almost at the level of the distal antenodal nervure; tropical and montane species	4
4.	Ground colour of body pale brown marked with black; wings tinted with pale yellow or palest brown	*Indolestes* Fraser.
	Ground colour of body azure blue marked with bronzed black; wings not enfumed or tinted	*Ceylonolestes* Kennedy.

Genus Lestes Leach (1815).

Lestes Leach, Edinb. Encycl. vol. ix, p. 137 (1815); Steph Ill. Brit. Ent. Mand. VI, p. 76 (1836); Ramb. Ins. Névr. p. 243 (1842); Selys, Mon. Lib. Eur. p. 135 (1840); Id. Rev. Oden p. 146 (1850); Id. Bull. Acad. Belg. (2) vol. xiii, p. 295 (1862); Kirby, Cat. Odon. p. 160 (1890); Tillyard, Biology of Dragonflies, pp. 276, 277 (1917); Lucas, British Dragonflies, p. 58 (1900); Laid. Rec. Ind. Mus. vol. xix, pp. 145, 146 (1920). Tillyard, Ins. Aust. and New Zeal. p. 78 (1926).

Puella Brulle, Expl, Moree, vol. ii. (i), p. 104 (1832).
Anapates, Charp. Lib. Eur., p. 18 (1840).

Characters of the subfamily; always resting with the wings nearly fully open; petiolation beginning a little before the level of *ac*, which latter is situated about midway between the level of the two antenodal nervures; pterostigma at least twice as long as broad; discoidal cell similar in fore and hind-wings, its base two-thirds the length of costal side; *IRiii* only slightly zigzagged; body with or without metallic markings.

Distribution. Cosmopolitan. Represented in India, Burma and Ceylon by several species and races. Genotype.—*Lestes sponsa* Hans.

Key to Species of Genera *Lestes and Platylestes.*

1.	Thorax without metallic markings ...	2
	Thorax with green metallic antehumeral stripes	5

2.	Pterostigma unicolorous	3
	Pterostigma bicolorous	4
3.	Vertex of head pale brown	*Lestes umbrinx* Selys.
	Vertex of head matt black	*Lestes thoracica* Laid.
4.	Thorax with about 10 small black spots on each side ; pterostigma white at both ends	*Platylestes platystyla Ramb.*
	Thorax immaculate ; pterostigma with its costal third palest brown, posterior two-thirds dark brown	*Lestes nodalis* Selys.
5.	Thorax with a uniform narrow antehumeral stripe on each side	6
	Thorax with narrow antehumeral stripes expanded outwardly at the upper ends.	8
	Thorax with antehumeral stripes deeply scalloped or crenulate on the outer sides	9
	Thorax with the whole of dorsum and forepart of sides brilliant metallic green	11
6.	Vertex of head metallic green ; thorax largely black ; only 11 postnodal nervures to forewings	*Lestes angularis* sp. nov.
	Vertex of head non-metallic ; 12 to 14 postnodal nervures to forewings	7
7.	Vertex of head pale brown ; dorsum of thorax pale brown with very prominent brilliant metallic green antehumeral stripes ; 12 postnodal nervures to forewings	*Lestes virridula* Ramb.
	Vertex of head matt black ; dorsum of thorax black with an obscure narrow metallic green stripe on each side ; 14 postnodal nervures to forewings	*Lestes patricia* Fraser.
8.	Sides of thorax pale brown with a few black points	*Lestes elata* Selys.
	Sides of thorax with two thick black bands enclosing a medial narrow brown stripe	*Lestes malabarica* sp. nov.
9.	Small species with abdomen 30–32 mm. and hindwing 20–21 mm.	10
	Larger species with abdomen 36–39 mm. and hindwing 24–26 mm.	*Lestes dorothea* Fraser.
10.	Mesothorax with a long irregular post-humeral stripe and a large lower spot of metallic green	*Lestes sikkima* sp. nov.
	Mesothorax without metallic or other markings	*Lestes præmorsa* Selys.
11.	Small species with abdomen about 30 mm. and hindwing 21 mm. ; pterostigma bicolorous ; palæarctic in distribution.	*Lestes barbara* Fabr.
	Large species with abdomen 52 mm. and hindwing 38 mm. ; pterostigma unicolorous ; oriental in distribution	*Lestes orientalis* Hagen.

Lestes præmorsa præmorsa, Selys (1862).

Lestes præmorsa Selys, Bull. Acad. Belg. (2) vol. xiii, p. 320 (1862) ; Id. Mitth. Mus. Dresd. vol. iii, p. 317 (1878) ; Id. *Odonates des Philippines*, Ann. Soc Espan. Hist. Nat. T. vol. xi, p. 49 (1882) ; Id. *Odonates de Birmanie*, Ann. Mus. Civ. Genov. vol. xxx, pp. 495, 496 (1891) ; Kruger Stett. Ent. Zeit.

p. 130 (1893) ; Laid. Proc. Zool. Soc. Lond. p. 382 (1902) ; Id. Rec. Ind. Mus. vol. xix, pp. 147, 154 and 155 (1920) ; Fras. Rec. Ind. Mus. vol. xxvi, p. 484 (1924).

Lestes præmorsus Kirby, Cat. Odon., p. 162 (1890).

Lestes decipiens Kirby, Journ. Linn. Soc. Zool vol. xxiv, pp. 565, 566 (1893) ; Laid. Rec. Ind. Mus. vol. xix, p. 154 (1920).

Lestes præmorsa subsp. *andamanensis* Fras. Rec. Ind. Mus. vol. xxvi, p. 410 (1924).

Male. Abdomen 32–35 mm. Hindwing 21–22 mm.

Head : labium yellowish ; labrum turquoise blue ; bases of mandibles glossy brown ; anteclypeus, cheeks and a narrow basal streak to postclypeus turquoise blue ; rest of head matt black, pruinosed over lower and back part of eyes ; eyes deep sapphire blue.

Prothorax black with obscure yellow markings largely hidden by pruinescence.

Thorax black on dorsum marked by a pair of dark green metallic antehumeral stripes, straight on their inner border, deeply crenulate or lobed on their outer. (This stripe subject to some variation, but usually with a somewhat quadrate lobe projecting from the upper end of stripe, a medial hooked, with or without a serrate hinder border, and an elongate clubbed lobe formed by an expansion of the lower part of stripe). Laterally blue or pale greenish yellow or in others (*decipiens*) black, heavily pruinosed so as to appear violaceous. In non-pruinosed examples, several irregular spots present on the sides, one on the upper part of humeral suture, two spots below this on mesepimeron, one a short distance behind the humeral-suture and the second or lower just touching the suture. Two spots on middle of mesepimeron, one at upper end of postero-lateral suture and another pair, rather wide apart, situated on the ventral border. Beneath thorax black heavily pruinosed. In melanotic examples, the metallic antehumeral stripes and lateral spots are almost or entirely obscured and the whole overlaid by pruinescence.

Legs black with a pale bluish green longitudinal stripe on the outer side of femora and extensor surface of tibiæ.

Wings hyaline or palely enfumed in adults ; pterostigma dark reddish brown or blackish brown, covering 2 cells ; 10 to 12 postnodal nervures in all wings ; *ac* slightly nearer the basal antenodal in the forewing, but about midway between the two antenodals in the hind ; *IRiii* situated about 5–6 cells proximal of the pterostigma in forewing, 8 to 9 in the hind.

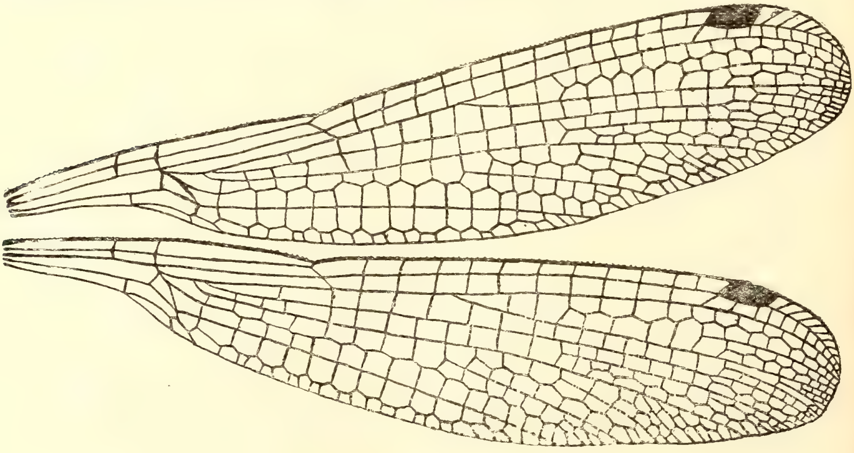


FIG. 3. Wings of *Lestes præmorsa*, Selys.

Abdomen pale blue marked broadly on the dorsum with bronzed green or coppery metallic changing to matt black on the hinder segments ; segment 1 with a broad quadrate spot of bronzed green on dorsum, not extending to apical border in subadults; segment 2 with a broad stripe shaped like an elongate thistle-head, falling short of both ends so as to leave a narrow basal bluish annule and a similar, broadly interrupted, one at the apical border; segments 3 to 7 with similar bands, the apical ends abruptly expanded and then contracted before joining narrow apical black rings, and with narrow basal and apical interrupted rings blue; segment 8 with only a vestige of the basal ring; segment 9 with a very large lateral spot of blue; segment 10 with a small ventro-lateral spot of the same colour. Segment 8 often with a large apico-lateral blue spot, obscured in some.

Anal appendages: superiors as long as segment 9, pale yellow or ochreous with the base and the apex black, forcipate, finely spined on the outer border near apex which is blunt and curved in strongly; on the inner side near the base, a robust spine followed by a thin shell-like expansion inwards which ends in a minute spine; inferior appendages much shorter, apposed at base where they are very broad and rounded, then abruptly contracted to form a short cylindrical ungulate process tipped with stiff whitish hairs.

Female. Abdomen 30-32 mm. Hindwing 20-21 mm.

Very similar to the male, differs as follows:—Labrum and cheeks more olivaceous or greenish yellow than blue; antehumeral stripes more distinct and more liable to variation; sides of thorax yellowish or pale greenish blue, heavily pruinosed beneath and on the lower parts of sides which are often chalky white; legs ochreous with the two anterior pairs of femora striped longitudinally with dark brown on the outer side; sides of abdomen greenish yellow; segment 1 with better defined markings, a baso-dorsal spot confluent with a small subdorsal spot on either side, the apical area pale and unmarked; borders and apical ends of segments 9 and 10 narrowly blue.

Anal appendages creamy white, short pointed conical. Vulvar scale pale, robust, extending to end of abdomen.

Distribution. The type, a female from Manilla, Philippines, is now in the Selysian collection. The allotype male, also in the same collection, was taken at Puepoli, Burma, in June. I have specimens from many parts of India, Burma and Ceylon which do not differ markedly from one another nor from the types. After examining a great number, I have come to the conclusion that the species cannot be split up, even into subspecies, beyond what I have already done by separating *dorothea* from it, and also by giving subspecific rank to examples from Sikkim, which I call *sikkima*. Owing to the gradual development of melanosis, a large number of varying forms are found ranging from pale brown with distinct markings in the teneral condition, to melanotic forms which are quite black and exhibit no markings. Kirby's form known as *decipiens* is merely one such as the last, very heavily pruinosed. The race *andamanensis* Fras., from Port Blair, is, I now think, not more than a variety and differs only by segment 10 without markings and by the pronounced character of the metallic stripes of thorax, which have the hinder border of the middle lobe serrate, a character since observed in other examples. These stripes differ rather widely according to whether the body of the stripe is thick or very fine, the lobes being much better developed when the latter happens. As regards the size, which, Selys mentions differs widely, I think this is due to an error in confusing *dorothea* with *præmorsa*. The distribution may be said to run from Western India, across to Assam and Burma and so throughout Southern Asia as far as the Philippines.

Lestes præmorsa sikkima, subsp. nov.

Male. Abdomen 34 mm. Hindwing 24 mm.

Very similar to *præmorsa præmorsa*, differing mosty by the metallic colouring of vertex of head and the metallic posthumeral stripe.

Head: labium yellowish; labrum, clypeus and cheeks olivaceous (possibly blue in the living state); back of eyes yellow with a large black spot below; vertex dark metallic emerald green except for a small oval spot of warm brown on the outer side of each hinder ocellus.

Prothorax pale brown with a triangular emerald green metallic dorsal spot and a linear subdorsal spot similarly coloured on each side; the whole base of posterior lobe emerald green metallic.

Thorax with a green metallic antehumeral narrow stripe with large lateral lobes, the medial one finely crenulate along its border; mesothorax with a posthumeral metallic green stripe made up of an upper spot finely confluent with a long wedge-shaped spot, and a small inferior lower posthumeral spot (some specimens have the upper spot discrete as well as the lower, but this is unusual). Beneath thorax pale yellow or white and without the large triangular black spot behind the legs seen in *præmorsa præmorsa.*

Wings with 11 to 12 postnodal nervures ; pterostigma blackish brown, covering 2 cells, otherwise details as for *præmorsa.*

Abdomen similar to *præmorsa præmorsa,* but segments 8 to 10 very broadly yellow at the sides (possibly blue during life).

Anal appendages not markedly different but the inner expansion of superiors ending in a more robust spine and the inferiors with a longer apical process.

Female : Abdomen 34–36 mm. Hindwing 26 mm.

Similar in most respects to the male but a much more robust insect. Anterior femora black except for the extreme base which is yellow, other femora black on the flexor surface only and stippled with a chain of small yellow spots,

Wings with 12 to 13 postnodal nervures ; pterostigma black, over 2 cells.

Abdomen, segment 1 pale prown, unmarked ; segment 1 with a small pale lateral spot, segment 9 with a very large lateral yellowish spot, whilst segment 10 is almost entirely yellow.

Anal appendages short conical, yellow at apices, basal half black. Vulvar scale black broadly marked with yellow.

Distribution. A number of specimens collected by Mr. Oscar Lindgren at Kurseong, Sikkim, all agreeing by having the metallic posthumeral stripe, which at once serves to distinguish it from typical *præmorsa.*

Type in the author's collection, paratypes in the Morton collection.

Lestes dorothea, Fraser (1924).

Lestes dorothea Fras. Rec. Ind. Mus. vol. xxvi, pp. 484 to 486 (1924).

Male. Abdomen 40 mm. Hindwing 26 mm.

Head : labium whitish yellow ; labrum, cheeks, bases of mandibles and frons turquoise blue, rest of head matt black ; eyes deep sapphire blue above, turquoise blue beneath.

Prothorax matt black. Thorax black, pruinosed white laterally, citron yellow beneath. Marked on the dorsum with metallic green antehumeral stripes shaped like those seen in *præmorsa præmorsa,* the area between these and on the outer side paler, followed by a diffuse black stripe on the humeral suture. A large diffuse black spot just in front of the upper part of the postero-lateral suture, another smaller spot at the middle of the antero-lateral suture and a third spot over the spiracle. Tergum and beneath thorax heavily pruinosed obscuring all markings. In melanotic specimens, especially those from Assam, all the above spots are entirely obscured and even the metallic stripes are made out with great difficulty.

Legs greenish yellow striped laterally with black ; tibial spines long, femoral short, 14 on the hind femora.

Wings hyaline, sometimes enfumed evenly ; pterostigma black, less than two and a half times as long as broad, covers 2 to 3 cells ; 15–16 postnodal nervures in forewings, 14–15 in the hind.

Abdomen blue or greenish blue marked with black as follows :—Segment 1 broadly black on dorsum, apical border narrowly blue, segment 2 with a broad thistle-head shaped mark on dorsum extending from base to apex, segments 3 to 6 with a broad dorsal stripe which expands abruptly near the apical end of segments and then contracts as abruptly to become confluent with a narrow apical black ring, whilst the basal end tapers to a fine point which just meets the apical ring of the segment before, leaving a small blue spot on either side. The apical expanded portion forms a complete broad ring round each segment ; segment 7 with a similar stripe which falls short of the base of segment ; segment 8 similar, with a fine basal blue ring, segments 9 and 10 entirely black, the latter pruinosed white on dorsum.

Anal appendages bluish during life, pale yellow after death, broadly black at base and apex, running straight back, the apices turned down and inwards at an angle of about 45 degrees ; basal half expanded on the inner side and with a very robust inner basal spine. Inferiors much shorter, not visible from above, widely separated, thick at base, with a short ungulate process at apex tipped with whitish hairs,

Female. Abdomen 36 mm. Hindwing 27 mm.

Differs rather markedly from the male in its ground colour and by its broader markings. Eyes olivaceous above and below, bluish behind; thorax olivaceous green, pale greenish yellow laterally; segment 9 with a large medio-lateral blue spot on each side; segment 10 entirely blue save for the middorsal carina which is finely black. Anal appendages small conical pointed black.

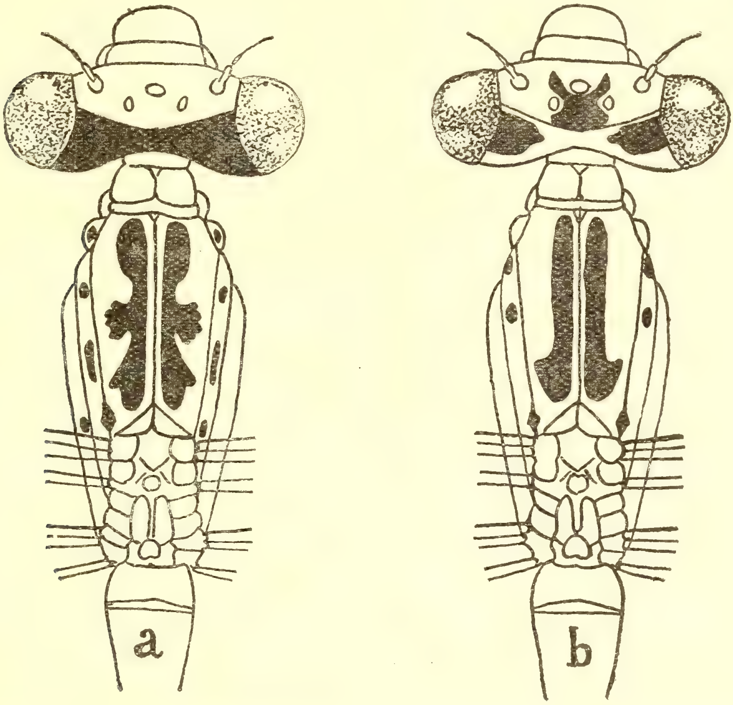


FIG. 4. Head and thorax of (*a*) *Lestes præmorsa*, Selys and (*b*) *Lestes elata*, Selys, showing the highly characteristic markings common to each group.

Distribution. I had thought this species to be strictly confined to Coorg, but I now think that the large melanotic species from Assam, which I had thought might be a definite species, are actually a near race of *dorothea*, characterized by their slightly smaller dimensions, greater melanosis and bright yellow thoracic sides. Some of these latter specimens are so black, that I am unable to discern any thoracic markings whatever, even the metallic ones being obscured. Younger ones however show the markings of *dorothea*. It is probably these specimens that Selys mixed up with true *præmorsa*. In Coorg it is to found on every tank, the pulping tanks of coffee estates being especially favoured, and here it may be taken usually in company with true *præmorsa*. Its much larger size and the absence of markings on segments 8 and 9 in the male, and its higher postnodal index will serve to distinguish it from *præmorsa*. Type in the British Museum, paratypes in the Indian, Pusa Museums and in many private collections including the authors'.

Lestes elata elata, Hagen (1858).

Lestes elata, Hagen, *Syn. Neur. Ceylons*, No. 36, Zool. Bot. Gesellsch. Wien. (1858); Selys, Bull. Acad. Belg. (2) vol xiii, p. 319 (1862); Laid. Rec. Ind. Mus. vol. xix, pp. 146, 153, 154, fig. 2 (1920); Fras. *Ibid.* vol. xxvi, p. 484 (1924); Laid. *Spolia Zeylanica*, vol. xii, pts. 47–48, p. 357 (1924).

Lestes elatus, Kirby, Cat. Odon. p. 162 (1890) ; Id. Proc. Zool. Soc. Lond. p. 203 (1891) ; Id. Journ. Linn. Soc. Zool. xxiv, p. 565 (1893).

Male. Addomen 34–36 mm. Hindwing 23–24 mm.

Head : labium white ; labrum, bases of mandibles, cheeks and anteclypeus turquoise blue ; postclypeus olivaceous marked at the base on each side with a small triangle of reddish brown narrowly bordered with black ; frons olivaceous green ; vertex between the ocelli and bases of antennæ black bordered outwardly by a broad band of light brown which extends obliquely forwards and outwards as far as the blue cheeks ; a large triangular spot of coppery bronze lying to the inner side of each eye above and narrowly edged with black ; behind eyes and the upper surface of occiput olivaceous yellow ; eyes turquoise blue. (Fully adult specimens have the whole of upper surface of head matt black and the bronzed spots obscured, whilst behind the eyes is black, heavily pruinosed white below).

Prothorax with middorsum olivaceous with a longitudinal diffuse narrow warm brown subdorsal stripe on each side in the middle of which is an irregular black spot ; posterior lobe with a large black spot on each side of the middle line (Adults have the dorsum black and the sides pruinosed white, the markings obscured).

Thorax in tenerals warm brown on dorsum changing to pale olivaceous and finally yellow on the sides or almost white beneath ; in adults dark reddish brown to almost black, heavily pruinosed at the sides and quite chalky white below and beneath. Dorsum marked with a pair of narrow antehumeral metallic green stripes expanded outwardly abruptly above ; these stripes very brilliant and prominent in young examples, but becoming gradually obscured by melanosis in adults, although rarely if ever quite obscured. On the sides, in tenerals, an upper tiny humeral spot and two or three equally small ones in a line on the lower part of mes and met-epimeron ; these spots not sharing in the general pruinescence of adult age and standing out prominently black against the white pruinescence ; in addition, in pruinosed adults, a narrow glossy stripe on the mesepimeron of the ground colour, which does not partake of the surrounding pruinescence.

Legs palest yellow in tenerals with a black stripe on the outer side of the femora, one on the flexor surface of the tibiæ and the whole of tarsi black. Adults similar, but more pale greenish yellow.

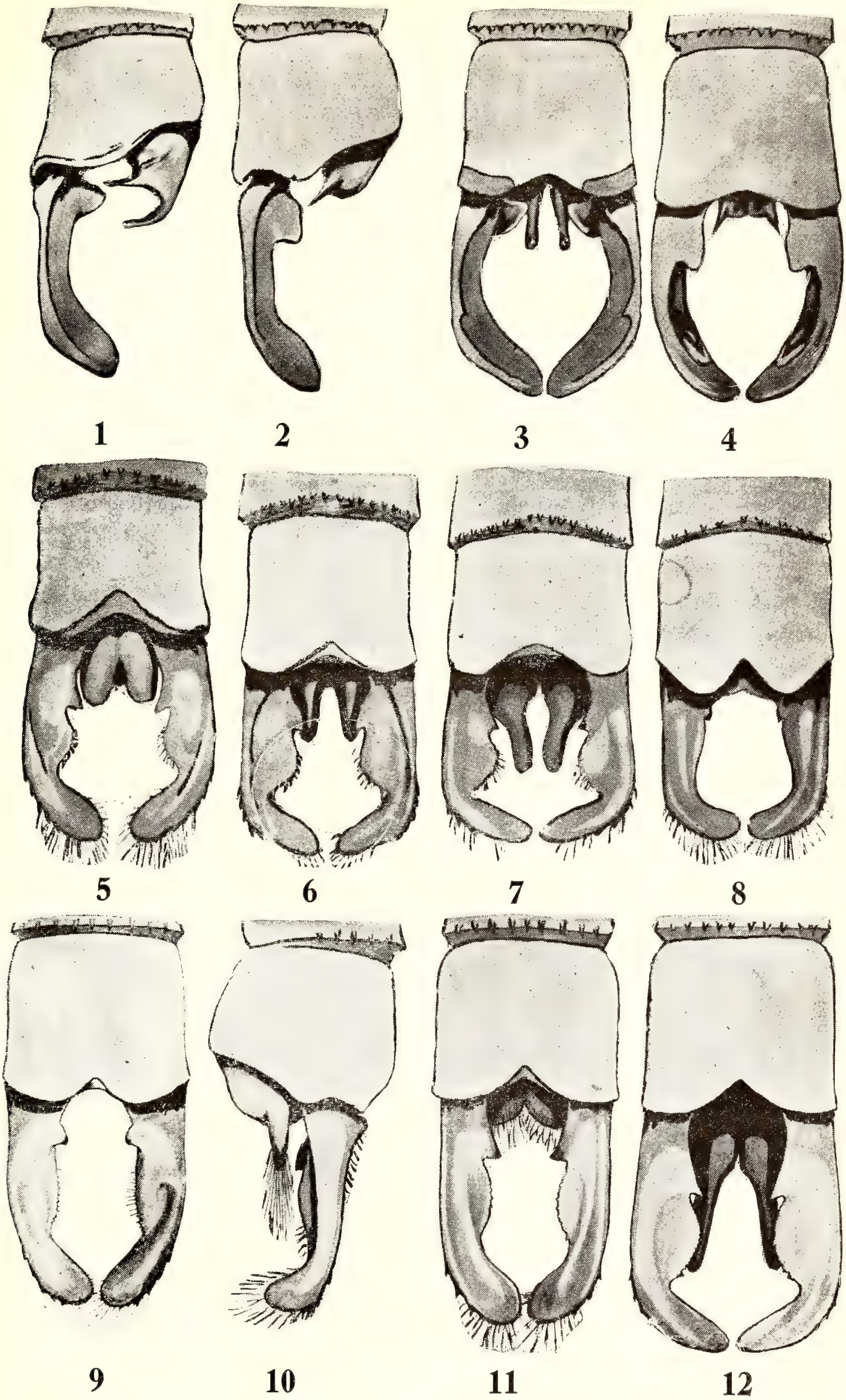
Wings hyaline ; pterostigma black in adults, pale brown in tenerals or dark reddish brown by transmitted light, covering 2 cells, about twice or two and a half times as long as broad ; 11 to 12 postnodals in forewings, 9 to 10 in the hind ; petiolation begins at *ac* which is situated about midway between the levels of the two antenodals.

Abdomen pale yellow at the sides in tenerals, pale bluish green in adults marked broadly on dorsum with metallic green or bronze changing to dull black on the terminal segments. Segment 1 unmarked in tenerals, obscurely brownish on dorsum in adults ; segments 2 to 6 with a broad metallic stripe on dorsum which expands abruptly near the apical ends of segments completely encircling them and, on the dorsum, narrowly confluent behind with a narrow black apical ring, whilst at the base rounded and leaving a narrow ring of the ground colour which is pale blue in adults ; segments 7 to 9 broadly dark brown on dorsum in tenerals, black in adults and leaving on the latter segment, a broad apical ring, yellowish in tenerals, bluish in adults. In very adult specimens all the terminal segments black, unmarked, the apical half of segment 9 and the whole of 10 white with pruinescence and very conspicuous when flying.

Anal appendages creamy yellow broadly tipped with black in tenerals, entirely black in adults, the apices tipped with yellow hairs ; a robust inner basal tooth followed by a wide dilatation which extends for half the length of appendage and is finely denticulate ; apical half narrow and curved strongly inward so that apices usually meet ; finely spined outwardly ; inferiors very short, about one-third the length of superiors, rounded at base, conical.

Female. Abdomen 34 mm. Hindwing 24 mm.

Somewhat similar to the male, but always less melanotic and the markings always well defined and the ground colour pale brown. Head similar to the male, but the metallic markings always in evidence and bronzed or coppery in adults ; thorax with the following lateral spots (undeveloped for the greater part in tenerals), a spot on the upper part of each lateral suture, five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ANAL APPENDAGES OF DRAGONFLIES
(*For explanation see end of this article*)

spots on the mesepimeron, three of which are posthumeral and one elongate, and one situate on the spiracle, two spots on the ventral border of metepimeron, the two pairs showing up very prominently when the thorax is viewed from beneath. Abdomen similar to the male, dorsal bands brown, non-metallic in tenerals, dark reddish brown with coppery reflex in adults; segment 9 with the band arrested short of the apical border and deeply bifid on dorsum; segment 10 and the apical part of 9 bluish, unmarked (yellowish in tenerals).

Anal appendages creamy white in tenerals, black in adults, short, conical; vulvar scale dark brown, very robust, extending to end of abdomen.

Distribution. Confined to Peninsular India and Ceylon, the form found in Burma being a distinct subspecies. It is the commonst species of the genus found within Indian limits and may be taken throughout the year in southern districts abounding around ponds and tanks during the monsoon months, hiding up in scrub jungle during the drier seasons. Very inconspicuous in the latter situations on account of its dull melanotic colouring, but a conspicuous and pretty insect when on the wing over tanks and paddy. I have seen it in hundreds over swamps in Mysore and equally so over paddy lands in Bangalore. The flight is short, like most Lestes, and when settled, it has a peculiar habit of swaying its abdomen, the reason for which is not at all clear but may be sexual as it is confined to the males.

I have been unable to detect any racial forms although varieties due to age differences are common. Females are comparatively rare over water, unless in cop, and oviposting, so that this sex must be sought for and beaten up in scrub adjoining water where it will be found in great numbers. Distinguished from other species by its metallic thoracic stripes with only an upper dilatation instead of two as in the *præmorsa* group.

The above description has been made from living specimens and may therefore be noted as considerably different from the original description of its author; it is however a carefully compiled one and made from insects undoubtedly conspecific with the type of *elata* in the Selysian collection. The differences arise from the fact that the original description was made from a dried specimen which had lost its colours from decomposition. The living insect is a much more beautiful insect than the drab creature depicted by Selys.

The wet season brood has a remarkably short larval existence of not more than ten weeks, as I have a note of imagos emerging in the second week of September from eggs which had been laid in the last week of the previous June.

Lestes malabarica spec. nov.

Male. Abdomen 24–25 mm. Hindwing 21 mm.

Head: labium white; labrum, bases of mandibles, cheeks and anteclypeus turquoise blue; postclypeus and vertex matt black; occiput and behind eyes ferruginous in tenerals, dark brown to blackish in full adults; a large triangular spot on the inner side of each eye dark metallic green extending forwards as far as cheeks as a dark cupreous band; eyes turquoise blue, paler beneath.

Prothorax blackish brown in adults thinly pruinosed laterally, pale yellow in tenerals changing to warm reddish brown on dorsum and dark brown on the posterior lobe.

Thorax with dorsum bright metallic green in tenerals and early adults, the middorsal carina narrowly, and an antehumeral stripe bright reddish brown, the metallic stripe but slightly or not at all expanded in its upper part; the anterior half of mesepimeron in tenerals blackish brown with the rest of the sides and beneath thorax creamy white, adults wholly black save for the lower part of metepimeron and a medio-lateral stripe interrupted by the spiracle which are light brown. The black portions densely pruinosed; beneath black overlaid by pruinescence save for an anterior ventro-latoral black spot on each side (the posterior corresponding spots found in *L. elata*, absent in this species).

Legs yellow with a parallel pair of black stripes on outer sides of femora; flexor surfaces of tibiæ black and, in adults, the inner sides of femora.

Wings palely and evenly enfumed in adults, hyaline in tenerals; pterostigma decidedly longer and narrower than in *L. elata*, covering 2 cells, black in adults, pale brown in tenerals ; 11 to 13 postnodal nervures in forewings, 10–12 in the hind ; petiolation ceases at *ac* which is situated rather nearer the distal antenodal nervure.

Abdomen with the sides azure blue, the dorsum broadly dull metallic ; segment 1 with apical half of dorsum metallic green in tenerals, dull bronzed in adults, the sides broadly azure blue with an oblique black stripe running upwards and basalwards form the apicolateral corner of segment but not meeting the base ; segment 2 with a broad thistle-head shaped stripe on dorsum extending from apical border to base of segment, the sides blue ; segments 3 to 6 with a narrow basal ring of blue and a subapical interrupted ring of pale yellow, the dorsum metallic green in tenerals, bronzed black in adults, this band tapered abruptly at base of segments and expanded as abruptly subapicad so as to encircle segments, finally contracted again and confluent with a narrow apical black ring ; segment 7 to segment 10 black, the last two, in tenerals, with large subdorsal pale blue to pale brown spots ; adults with the dorsum of segments 9 and 10 pruinosed white.

Anal appendages : superiors differing widely from those of *L. elata* in that they are bent sharply inwards at the junction of apical and middle thirds at nearly a right angle ; apices bent strongly downwards as seen in profile ; a subbasal robust spine longer than that seen in *L. elata* on the inner side of appendage, followed by a broad thin expansion minutely denticulate on the inner side, after which the appendage is abruptly angulated inward ; outer border near apex coarsely spined but no tuft of hairs at apex as in *L. elata*. Inferior appendages also differing from those of *L. elata* ; seen from the side, about half the length of superiors, broad and rounded at base, then narrowly constricted as a short unguate process resembling that seen in *præmorsa* but broader and without the apical pencil of hairs. Superiors white tipped with black at apex and broadly black at base in tenerals, wholely black in adults ; inferiors white at base, apical process glossy black.

Female. Abdomen 32–33 mm. Hindwing 22–23·5 mm.

Very similar to the male, but the ground colour more greenish than blue and decidely yellowish in tenerals. The metallic antehumeral stripes dilated above as in *L. elata ;* the sides of thorax presenting only 5 black spots or points, the medial posthumeral one being metallic green and very small.

Wings hyaline but evenly enfumed in adults, 11–13 postnodal nervures in forewings, 10–11 in the hind ; pterostigma dark reddish brown to nearly black according to age of specimen.

Abdomen with dorsum bright green metallic to cupreous in tenerals but dull cupreous in adults as far as segment 6, then dull matt black ; segment 10 entirely yellow, segment 9 laterally, and for its apical half and the sides of segment 8, yellow. (In adults these markings change to blue and finally matt black).

Anal appendages short conical yellow in tenerals, bluish in adults. Adults have a dense pruinosity beneath thorax and prothorax but rarely exhibit any on the sides or terminal segments of abdomen.

Distribution. South Malabar and Cochin. An annual migration is seen northwards to North Malabar just previous to the S. W. monsoon, but there is no evidence that the species ever establishes itself as there are no suitable breeding places after the paddy lands have dried up. South Malabar and Cochin, on the other hand, abound with suitable tanks and ponds in which the species breeds in great abundance and almost completely crowds out *L. elata* and *præmorsa*. It is to be distinguished from the former by the shape of the superior and inferior anal appendages and also by the absence of the conspicuous hinder ventro-lateral black spot on thorax ; from the former, the shape of the metallic humeral stripes will at once serve to distinguish it. Type in the Fraser collection, paratypes in the Laidlaw and Morton collections. Paratypes will be placed in the collections of the Indian, Pusa and British Museums.

Lestes angularis, sp. nov.

Male. Abdomen 34 mm. Hindwing 22 mm.

Head : labium pale ochreous ; labrum olivaceous ; base of mandibles and cheeks bluish ; epistome, frons and vertex matt black marked with a small tawny triangular spot on the outer side of each hinder ocellus ; a large triangular area to the inner side of each eye dark metallic green; behind eyes black. (Probably the labrum is blue during life)

Prothorax matt black, pruinosed on the sides.

Thorax with the middorsal carina narrowly dark ochreous, the alar sinus and dorsum as far out as the humeral suture matt black marked by a narrow antehumeral metallic green stripe of even width, on each side ; mesepimeron black marked by a U-shaped spot anteriorly and an interrupted stripe posteriorly ochreous ; metepimeron black save for the posterior border which is narrowly ochreous ; beneath black.

Legs yellow, femora striped longitudinally with black on inner and outer sides ; tibiæ blackish on flexor surface.

Wings hyaline ; pterostigma dark reddish brown, broad, about twice as long as broad, inner and outer ends oblique ; 11 postnodal nervures to forewings, 9 to 11 to the hind ; *ac* meeting *ab* at hinder border of wing ; *ac* situated about midway between the two antenodal nervures.

Abdomen yellow or bluish at the sides and beneath, metallic green on dorsum from segments 1 to 7, matt black from segment 8 to the end ; dark metallic bands on segments 3 to 7 dilated subapicad so as to encircle the segments completely, then narrowed to become confluent with fine terminal black rings, whilst basad, the bands fall short of the base to leave narrow blue basal annules ; segment 10 deeply notched.

Anal appendages ; superiors tawny tipped broadly with black, the base with a robust inner spine which is immediately followed by a dilatation which extends for a little beyond the middle of appendage, at which point the latter is bent abruptly inward at a right angle ; apices blunt, coarsely spined on the outer side ; inferior appendages very short conical processes barely extending as far as basal spine of superiors, dark reddish brown in colour.

Female. Abdomen 32 mm. Hindwing 22 mm.

Ground colour of head and body generally paler, that of head dark reddish brown on frons and vertex with smaller black areas, the triangular metallic spots much more conspicuous, the tawny spots on outer sides of ocelli larger and finally the occiput and upper part of back of eyes pale ochreous.

Prothorax pale ochreous with an irregular black dorsal spot shaped like a bull's head with diverging horns.

Thorax bright ochreous, the middorsal carina and the shape of the metallic antehumeral stripes as for the male ; two small black spots on anterior part of mesepimeron.

Legs marked as for the male but brighter ochreous.

Wings similar to the male, 11 postnodal nervures in forewings, 10 in the hind ; pterostigma dark yellow between black nervures, more than twice as long as broad.

Abdomen with segment 1 pale ochreous, unmarked ; segment 10 and apical half of segment 9 pale blue, this colour extending broadly on the sides of latter segment. Anal appendages ochreous, short, conical.

Distribution. Lower Burma. Type male from Minbu, now in the Pusa collection, collected 8. viii, 14.

Closely resembles *L. elata* from which it differs by the angulation of the superior appendages and the antehumeral metallic stripes of even width throughout. In the latter respect it resembles *L. viridula*, as indeed also by the angulation of appendages, but the latter species has no black markings and has no metallic markings on head.

Lestes viridula, Rambur (1842).

Lestes viridula Ramb., Hist. Nat. Ins. Névrop. pp. 252–253 (1842) ; Selys, Syn. Agrion, p. 38 (1862) ; Laid. Rec. Ind. Mus. vol. xix, p. 153 (1923); Fras. Rec. Ind. Mus. vol. xxvi, p. 487 (1924).

Lestes viridulus Kirby, Cat. Odon., p. 163 (1890).

Male : Abdomen 34–35 mm. Hindwing 23–24 mm.

Head : labium palest yellow ; labrum, clypeus, frons, vertex and occiput pale brown deepening to chocolate brown on vertex and occiput ; bases of mandibles and cheeks palest brown tinted with golden yellow ; behind eyes pale yellow ; eyes brown above, golden yellow below.

Prothorax uniform pale khaki brown, unmarked.

Thorax pale khaki brown or fawn paling to creamy white low down on sides and beneath, which latter is pruinosed white ; dorsum of thorax with two very narrow conspicuous metallic green stripes running closely parallel to the middorsal carina, the area between them warm reddish brown ; no spots on thorax.

Legs pale yellow with black spines.

Wings hyaline : pterostigma khaki brown, very narrow, four times as long as broad, covering 2 cells ; *ac* meeting *ab* at hinder border of wing at a level rather nearer the distal antenodal nervure at which level petiolation begins ; 11 to 12 postnodal nervures to forewings, 9 to 12 in the hind.

Abdomen pale yellow at the sides and almost white beneath ; warm reddish brown on dorsum with a cupreous reflex, paler of segments 1, 9 and 10, the latter very pale brown or yellow ; all segmental joints ringed narrowly with blackish brown ; segments 3 to 6 with diffuse rather obscure dark brown subapical rings ; segment 9 with a short dark brown carinal stripe on its basal half.

Anal appendages yellow tipped with black ; superiors rather longer than segment 10, broad at base where there is a very robust sub-basal spine, after which the usual expansion occurs broadening to about the middle of appendage and finely denticulate along its inner border. At the termination of this dilatation the appendage bent abruptly in at an obtuse angle, and, as viewed from the side, rather strongly downwards ; coarsely spined on outer side of angulation. Inferiors half the length of superiors, broad and rounded at base, then truncate and blunt at apex, directed straight back somewhat like the same appendage in *præmorsa* but without the stiff pencil of hairs at the apex.

Female. Abdomen 34 mm. Hindwing 24 mm.

(This sex does not appear to have ever been described, as it was unknown to Selys.)

Coloured exactly as in the male except segment 8 which has a narrow blackish brown middorsal spot on carina extending nearly to apex of segment, and a broader and more conspicuous middorsal mark on segment 9 on the basal three-fourths of segment ; segment 10 very pale brown.

Wings very similar to the male but pterostigma is distinctly longer and narrower ; 12 to 13 postnodal nervures to forewings, 11 to 12 in the hind.

Legs with a longitudinal dark brown stripe on all femora not quite extending to base of limb and more conspicuous on the two anterior pairs.

Anal appendages palest brown, short conical pointed ; vulvar scale very robust, extending nearly to end of abdomen, darkish brown.

Distribution. Confined to Peninsular India, especially to the Deccan and Western India. It is commonest during the dry seasons and is to be sought for among long dry grass, the colour of which it simulates closely. Usually, where found, quite common ; in a colony found in South Coorg, I took a score of couples in as many minutes. The type comes from Bombay and is in the Rambur collection or Paris Museum : I have found it myself quite common on Elephanta Island, Bombay. Easily distinguished from all others by its uniform pale brown colour combined with a pair of dorsal thoracic green metallic stripes of uniform width.

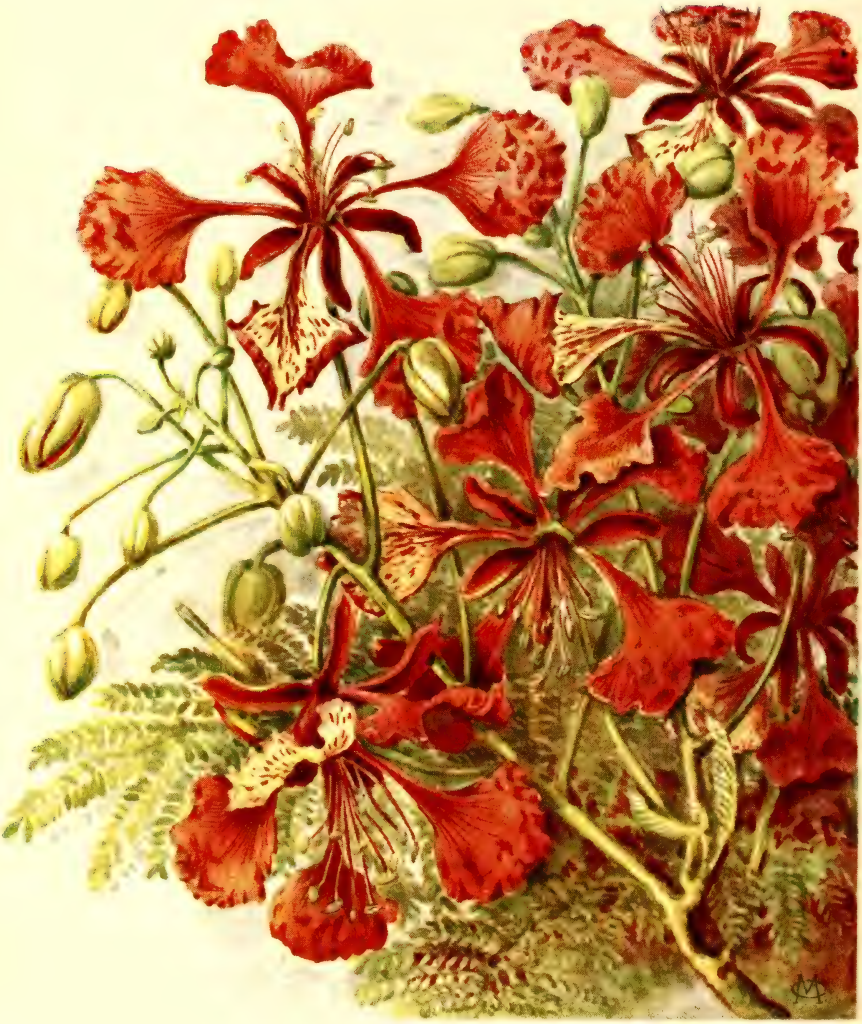
EXPLANATION OF PLATE II

1. Right lateral view of anal appendages of *Megalestes irma* Fras.
2. The same of *Megalestes major* Selys.
3. Dorsal view of anal appendages of *Megalestes irma* Fras.
4. The same of *Megalestes major* Selys.
5. Dorsal view of anal appendages of *Lestes elata* Selys.
6. The same of *Lestes malabarica* sp. nov.
7. The same of *Lestes viridula* Ramb.
8. The same of *Lestes angularis* sp. nov.
9. The same of *Lestes praemorsa* Selys.
10. Left lateral view of anal appendages of *Lestes præmorsa* Selys.
11. Dorsal view of anal appendages of *Lestes dorothea* Fras.
12. The same of *Lestes patricia* Fras.

FROM CAMERA LUCIDA STUDIES DRAWN TO THE SAME SCALE

FIG. 4. Wings of *Lestes præmorsa* Selys.

(*To be continued.*)



Poinciana regia.

SOME BEAUTIFUL INDIAN TREES [1]

BY

E. BLATTER, S.J., Ph.D., F.L.S. AND W. S. MILLARD, F.Z.S.

PART II.—(*With two coloured plates and two black and white plates and five text figures*).

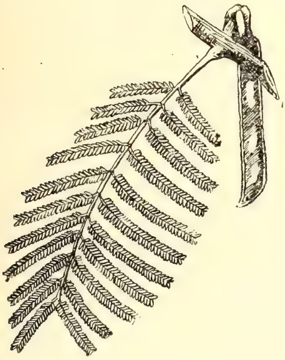
(*Continued from page 635 of this volume.*)

THE GUL MOHUR

Popular Names: Gul Mohur, Goolmohr tree, Gold Mohur, Gold Mohr, Royal Gul Mohor, Flamboyante.

Poinciana regia, Bojer Bot. Mag. t. 2284 (*Cæsalpiniaceæ*) (After M. de Poinci, Governor of the Antilles in the 17th century).

One of the compensations of the hot weather in India is the profusion of beautiful flowering trees and perhaps one of the most conspicuous from April to June is the Gold Mohur. In Madagascar, the tree is called '*Flamboyante*' and by some the '*Flame of the Forest*', a name which appears to be given to several trees in this country, including the Coral tree (*Erythrina indica*), described in part I of this serial, but we consider, in India, the name is particularly and only applicable to the Palas or Dhak tree (*Butea frondosa*).



Description : A large deciduous tree, growing from 40–50 feet in height with spreading branches and very handsome feathery leaves. The foliage is particularly beautiful when the tree is young and the airy elegance of its leaves more in evidence. The leaves may attain a length of two feet. The leaf is composed of from 11–18 pinnæ or minor leaves arranged in pairs along the midrib. The pinnæ bear from 20–30 pairs of small oblong leaflets, each measuring from $\frac{1}{3}$ - $\frac{2}{5}$ by $\frac{1}{10}$ - $\frac{1}{6}$ inch. The tree sheds its leaves between February and March and during this period, which immediately precedes its flowering season, it stands gaunt and bare save for the long, sabre-like seed pods, hanging from its leafless branches. The young leaves appear towards the end of May or early in June, and by the time the rains are well established, the tree is once again covered with its feathery foliage. The flowers appear with the onset of the hot weather, a few at first, then more and yet more till by mid-May the tree is a vivid and brilliant mass of scarlet blooms. The flowers are arranged in immense racemes at the ends of the branches. Individually examined, each flower is seen to be composed of 4 scarlet petals, while the fifth, the standard petal, is slightly larger in size and much variegated in colour. It is yellow or white and usually streaked with red. The flowers vary considerably in intensity of colouring. A whole range of tones from orange-vermillion to deep scarlet is exhibited. The deep scarlet form is particularly handsome. Each petal appears as a rounded spoon-shaped blade with a delicately crinkled margin. Its base is long and narrow, technically described as clawed. The petals emerge from between 5 fleshy scarlet-faced sepals which constitute the calyx. The stamens protrude in a cluster of 10 red filaments, surrounding a tender green style. The whole flower measures about 4 inches across.

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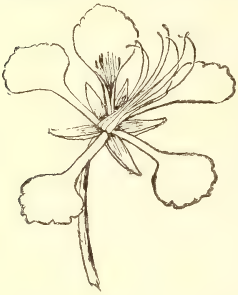
[1] Part I of this series appeared under the title of 'Conspicuous Flowering Trees of India'; it has since been decided to issue the serial under the present title.



Flowers during the hot weather.

Fruit : The pods are green and flaccid when young. They harden with age, turn a deep brown and remain for a long time on the tree. They measure from 1–2 feet in length. The seeds are oblong and transversally mottled.

Distribution : A native of Madagascar introduced within the last 100 years.

Uses : Largely used as an ornamental tree in the warmer parts of India, Burma, Ceylon and the Malay Peninsula.

Gardening : Usually grown from seed, also raised from cuttings. The form with deep scarlet flowers is so handsome that it deserves wider propagation. As the seeds may not come true to colour, it would be advisable to make cuttings of this variety, of which there are a good number in and around Bombay. The Gul Mohur is a fast growing tree. It has spreading superficial roots which kill out other plants. The shallow root system unfortunately renders it liable to be blown down during storms.

The Gul Mohur is often confused with the Peacock Flower or Barbadoes Pride (*Cæsalpinia pulcherrima*) better known as *Poinciana pulcherrima* and often referred to in this country as the Gold Mohur Shrub. This plant is a shrub or at most only a small tree, with strongly over-lapping calyx segments in the bud, much smaller flowers and very long protruding stamens (Stewart).

THE WHITE GUL MOHUR

Popular names : White Gold Mohur; Nirangi (Kan.), Sunkeswar (Tel.), Pandenaryan (Tam.), Sandesra (Mar.).

Poinciana elata, Linn. Cent. Pl. ii (1756) 16.

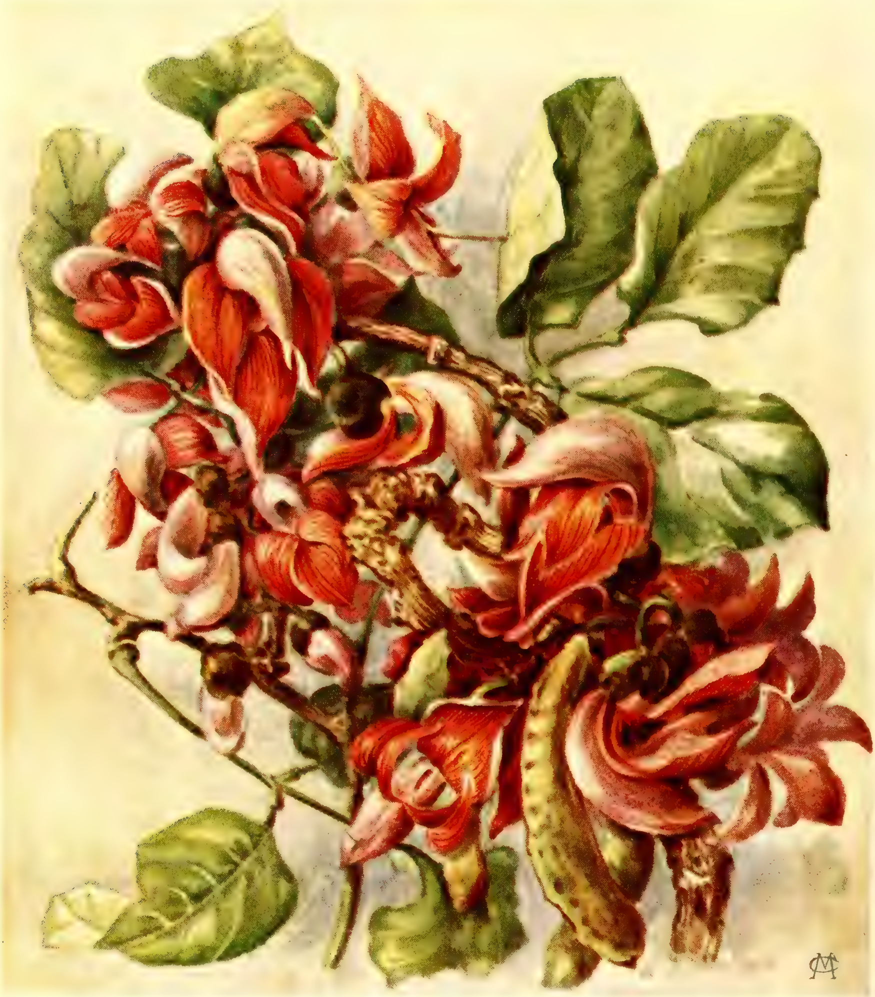
Description : An erect tree growing 20–30 feet in height with a tolerably smooth ash-coloured bark. The leaves are similar in

Photo by C. McCann.

The Gul Mohur (*Poinciana regia*) in flower.

Photo by C. McCann.

The Gul Mohur (*Poinciana regia*) in fruit.



Butea frondosa.

character but smaller than those of *P. regia*, being from 4–8″ long. The main or mid-rib of the leaf carries a smaller number of minor ribs or pinnæ, there are from 4–8 pairs arranged opposite. The leaflets, almost stalkless, are closely set in from 10–20 pairs along the ribs. Their shape is linear-oblong, somewhat pointed at the apex. They are quite smooth and readily shed. The flowers grow at the end of the branches in racemes. There are not many flowers in each cluster. The stalks of the lowest flowers are longest, thus all the flowers forming the cluster come up to the same level (corymbiform). The pedicels or stalks of the flowers are downy (pubescent). The calyx, ¾–1″ long, is leathery and, like the stalk, covered with a silky down externally. The sepals or segments of the calyx are oblong, very narrow and sharp-pointed. The petals are white at first and then change to yellow. The upper petal is usually smaller and of a deeper colour than the others. The petals do not project much beyond the calyx; in shape they are almost round (sub-orbicular) and very much curled at the margins. The stamens are downy, dark coloured, from 2–4″ long, and thickened at the base. The pods measure from 5–7″ by ¾ to ¼′′. They are smooth, narrowed at both ends and marked with a net-work of veins. The seeds number 4–8.

Flowering Season : August–March (Brandis); June–September (Cooke); in the hot season or early rains (Troup). Therefore practically the whole year. Troup calls it a practically evergreen tree.

Distribution : Abyssinia, Arabia, in India perhaps indigenous in the Porebunder State. Cultivated in many parts of India.

Gardening : Capable of growing in poor dry soil, even in crevices of rocks, where, however, it is stunted. Often cultivated for ornament. It grows fast and is easily raised from seed.

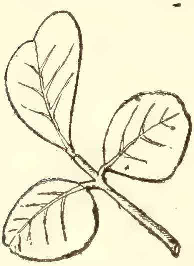
THE FLAME OF THE FOREST

Popular Names : Flame of the Forest, Butea gum, Bengal Kino, Bastard Teak; Palas, Dhak, Kakria, Chalcha (Hindi), Muttuga (Kan.), Palas, Paras (Mar.), Parasul (Tam.), Modugu (Tel.), Pauk (Burm.).

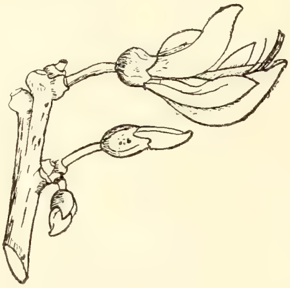
Butea frondosa, Konig ex Roxburgh Asiatic Res. iii (1792) 469. (Called so after the Earl of Bute).

This is the tree we consider the true 'Flame of the Forest'. In parts of the country where these trees abound, such as the forests of the Western Ghats and Central India, their massed crowns of bright orange flowers, seen in the glitter of the sunlight suggest the semblance to a forest in flames. So brilliant, so vivid is their colouring!

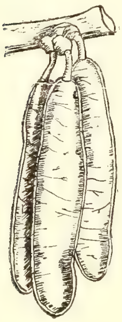
Description : An erect tree growing from 20 to 40 feet in height with a crooked trunk and irregular branches. Its bark is ash-colour and rough though the younger portions of the tree are downy. The leaf is trifoliate. It is composed or made up of three leaflets, leathery in texture. The old leaves are hairless above and finely silky below; this silky covering gives the leaves a peculiar greyish appearance when seen from a distance. The net-work of veins stands out very conspicuously beneath the leaf. The terminal leaflet is a blunt oval in shape. It is described as obovate, or rounded at the apex and narrowing to a wedge at its base. It measures from 4–8″ in length and is about as broad as long. The lateral leaflets are broader at the base and more rounded. They measure from 4–6 by 3–4 inches. The main stalk of the leaf is quite 4 to 6″ in length, those of the leaflets are about a quarter of an inch.



Grouped in threes along a velvety, dark olive green stalk, the handsome flowers grow in great profusion in stiff racemes, about 6″ long. The individual stalks of the flowers are about twice as long as the calyx, which is deep velvety, olive green externally and clothed with silken hairs within. The rich dark tones of the stalks and the calices present a striking contrast to the flaming orange colouring of the petals. The outer or under surfaces of the petals take on a salmon pink tone due to a delicate covering of silvery hairs. Five petals are apparent. A standard petal, about an inch broad, two smaller wing petals and a much curved, beak shaped keel which is really formed by the fusion of two petals. The stamens are practically enclosed within the keel. There are 10 of them, 9 united in a bunch and one free.



The pod when young is pale green. When ripe, it fades to a pale yellowish brown or grey. It carries a silvery white sheen. It is extremely flat and thin except at the apex where a slight thickening indicates the position of its single seed. A thickening is also seen along the margins.



The leaves begin to fall at the end of November or during December. By the end of January some trees are leafless or nearly so. Others retain their leaves, especially on the lower branches, during the flowering season, up to the end of March. New leaves appear in April or early May and are of a delicate fresh-green colour.

Flowering Season :—The flower buds are blackish and appear on the bare branches in January, and from the end of that month up to the end of March, the trees announce the approach of the hot weather by bursting into a blaze of flaming orange flowers, presenting a gorgeous sight. When in flower, the tree is either entirely leafless or there are some leaves on the lower branches. The flowers cover chiefly the upper part of the tree. Flowering continues, according to locality, up to the end of March or even to the end of April. The time of flowering is greatly

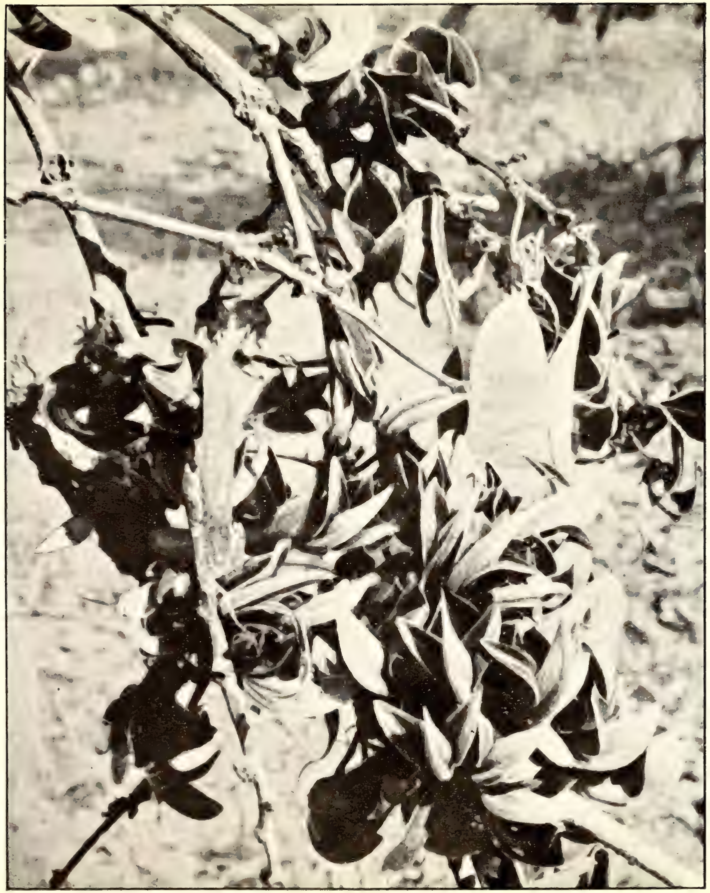


Photo by C. McCann.

The Flame of the Forest (*Butea frondosa*).
A flowering branch.

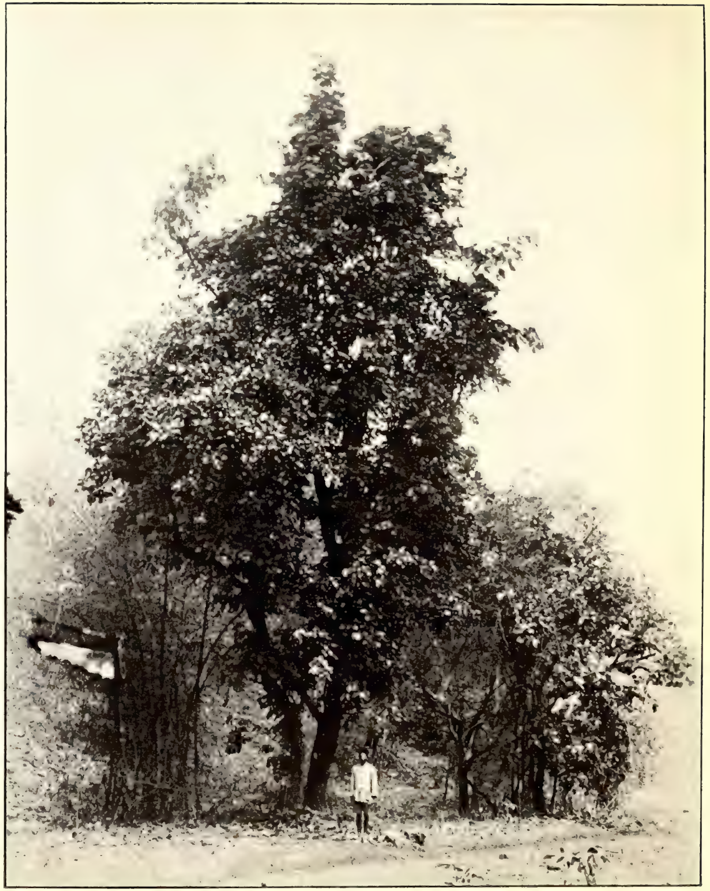


Photo by C. McCann.

The Flame of the Forest (*Butea frondosa*).
General appearance.

influenced by seasonal conditions. In dry seasons the flowers appear earlier than usual.

The pale green flat pods develop very quickly and in April the leafless trees, covered with green pods, give the impression of being in full foliage.

Distribution : Common throughout the greater part of India and Burma. In the outer Himalayas it ascends to about 3,000 feet, in Southern India to 4,000 feet. In the most arid regions it is rare or absent. In open grass lands the tree is very typical and is often found gregarious.

Gardening : The long pod has only one seed near the top. On germination the seed remains in the pod which opens at the tip and allows the young shoot and root to emerge. The cotleydons remain attached to the seedling for a considerable time. Growth is greatly stimulated by weeding and irrigation and Troup is of opinion that the former is even more important than the latter. The thick long tap-root is often devoured by pigs, rats and porcupines. The roots have a wonderful power of recovery and any part not destroyed by animals will send up new shoots.

Uses : A ruby coloured gum exudes from the tree either naturally or from artificial scars. The gum is used both as a dye and a tan. It it also used medicinally as a substitute for true Kino-gum, yielded by the Indian Kino tree (*Pterocarpus marsupium*) and is sold as such under the name of Bengal Kino. From the inner bark a strong fibre is obtained which is used for rough cordage and for caulking boats. A clear bright oil extracted in small quantities from the seed possesses anthelmintic and purgative properties. The leaves serve as plates and are also used for making umbrellas. They are used as manure and given as fodder to buffaloes. An infusion of the flowers dyes cotton, previously prepared with alum, a bright yellow, which may be changed by an alkali into deep orange. The Lac insect is frequently found on the smaller branches. The quantity of lac produced on *Butea* is said to be greater than on any other tree. The wood resembles teak in appearance. It is not very durable above ground, but it is said to be much more serviceable under water, hence its use for well curbs, piles and water scoops of wells. It is also used for gunpowder charcoal (Talbot). The flowers are offered by the Ho to their God, Desauli Bonga.

Varieties : In volume vi, p. 107, of the Society's *Journal*, Mr. H. T. Ommaney of the Bombay Civil Service, records a variety of *Butea frondosa* which he observed at Ghodra in the Panch Mahals. Instead of the customary dazzling blaze of orange, the flowers were a pale yellow. The base of the petals were primrose-yellow shading to a creamy tint on the edges and on the reverse sides. Col. C. E. Luard describes a variety seen by him in Manpur Pargana, Central India Agency which produced golden yellow flowers. He described their colouring as similar to that of the sun flower. (*Journ. Bomb. Nat. Hist. Soc.*, vol. xxiv, p. 305). A yellow variety is also known from Amraoti, Berars. Seeds of this variety sent to Mr. W. S. Millard in Bombay were planted, one tree is now growing in the Ladies' Gymkhana, Malabar Hill.

THE CLIMBING PALAS

Popular Names : Climbing Palas; Palasvel (Mar.), Pauknwe (Burm.), Morud (Kol.), Nari-murup (Santali), Dorang (Kharw.).

Butea superba, Roxb. Cor. Pl. t. 22.

A gigantic woody climber with a stem as thick as a man's leg, with very large long pointed leaflets. The leaflets are much larger than those of *B. frondosa*, usually 12–18″ in length attaining quite 20″ in young plants. The climber is crowded, when leafless, with gorgeous orange scarlet flowers. The flowers again are much larger than those of *B. frondosa* and are borne on stalks three times the length of the calyx.

Flowers : The climber flowers between March and April. The pods ripen in June and July and the leaves are shed between February and May. The pods are like those of *B. frondosa.*

Uses : The economic properties are similar to those of *B. frondosa.*

Distribution : Central and Southern India, Burma.

(*To be continued.*)

LIFE-HISTORY NOTES ON *LAMPROSEMA INDICATA* (PYRALIDÆ), A CATERPILLAR PEST OF CHRYSANTHEMUMS.

BY

M. C. **CHERIAN**, B.A., B.SC., D.I.C.,

Madras Agricultural Department.

INTRODUCTION :—About three miles from Dindigal Railway Station in Madura District lies the village of Vellodu where some of the ryots have taken to the cultivation of Chrysanthemums on a small scale and derive a fair amount of profit by supplying flowers to the neighbouring markets. The soil is a sandy loam and is well suited to the cultivation of these plants. Three varieties grown here are (1) the big yellow, (2) the big white and (3) the small yellow, the last one being the country variety. Root suckers from the previous crop are transplanted in early June. Flowering, in the case of the first two varieties, begins from October and continues to the end of November, while in the last it is late by about a month.

Last year the ryots of the village applied to the Government Entomologist, Coimbatore, for help against the ravages of the Chrysanthemum caterpillar. An officer was deputed to study the pest and suggest remedial measures against it. The present paper aims at giving a short account of the life-history and habits of this pest studied at the Insectary at Coimbatore and also the best method of destroying it.

NATURE, EXTENT AND TIME OF DAMAGE :—The pest generally appears about the time of flowering. The caterpillars generally only attack the leaves, but in some cases they have been known to destroy the flowers also. In certain years the pest is reported to occur in very large numbers and bring about a complete defoliation.

LIFE-HISTORY :—Adult moths are yellowish in colour with wavy markings on the wings. They measure about 20 mm. in length. Eggs are generally laid on the under surface of the leaves two to three days after emergence. Nine females laid 2,966 eggs, with an average of 330 per moth, the maximum number being 499 (*vide* Tables I and II). Eggs are pale white in colour and measure 1 mm. long and ½ mm. broad.

The newly hatched larvæ are about 1½ mm. long and ¼ mm. broad and pale white in colour. They generally feed in small patches, leaving the epidermis intact. After the first moult they assume a green colour and are 3¾-4 mm. long and ½ mm. broad. Two horizontal stripes are seen on either side of the caterpillar. After the second moult they are 6 mm. long and 1 mm. broad and two white dorsal stripes and two others on each side are visible. After the third moult they measure 8 mm. long and besides the four stripes two more appear, these being not so prominent as the other four. After the fourth and final moult they measure 12–13 mm. long. Just before pupation they assume an yellowish colour and measure 14 mm. in length. From Table III it will be noticed that the first instar takes three days, second two days, third two days, and fourth two days. They undergo four moults in all. Just before pupation the larvæ spin adjacent leaves together and build the cocoons therein. In cases where leaves happen to touch the ground, cocoons are built between the leaves and the soil. Cocooning takes about two days. The pupal period lasts six days.

LONGEVITY OF ADULT MOTHS :—The whole life cycle covers 23 to 30 days (Table IV). One moth lived 23 days being fed with jaggery water and this is the maximum recorded for this species of moth. Four other moths lived 17, 16, 13 and 11 days respectively. (See Table V).

REMEDIAL MEASURES :—Lead arsenate and Paris Green (Copper aceto-arsenite), two stomach poisons, were tried against these caterpillars.The former was sprayed at a strength of ½ oz. in one gallon of water and the latter dusted in the proportion of one part of Paris Green to five parts of lime. It was found that the lead arsenate spray gave better results than Paris Green though both of them were effective. Since lead arsenate does not burn foliage as Paris Green sometimes does, it was recommended for use by the ryots.

PARASITES :—A small wasp belonging to the Family *Elasmidæ—Elasmus indicus*—was found to parasitise the caterpillars though not found in sufficiently large numbers to check the pest.

TABLE I

Egg laying Records.

Date	Pair A.	Pair B.	Pair C.	Pair D.
20–10–27	Emerged	Emerged	Emerged	Emerged.
21–10–27	61 eggs laid.	No egg.	No egg.	85 eggs laid.
22–10–27	206 eggs.	No egg.	179 eggs.	96 eggs.
24–10-27	8 eggs.	No egg.	48 eggs ♂ died	27 eggs.
25–10–27	67 eggs.	No egg.	79 eggs.	84 eggs.
26–10–27	♀ died.	139 eggs.	1 egg.	42 eggs. ♂ escaped.
27–10–27	...	5 eggs.	44 eggs.	25 eggs.
28–10–27	...	27 ♂ and ♀ died.	30 eggs.	7 eggs.
29–10–27	...	...	19 eggs.	2 eggs.
30–10–27	...	...	8 eggs.	♀ died.
31–10–27	...	...	13 eggs.	...
2–11–27	...	...	♀ died.	...
5–11–27	♂ died.	...	...	...
...	342 eggs.	171 eggs.	421 eggs.	368 eggs.

TABLE II

Egg-laying Records.

Date.	Pair A.	Pair B.	Pair C.	Pair D.	Pair E.
14–11 28	Emerged.	Emerged.	Emerged.	...	...
15–11–28	68 eggs.	No egg.	92 eggs.	Emerged.	..
16–11–27	137 eggs	No egg.	138 eggs.	No egg.	Emerged.
17–11–27	90 eggs♂died.	105 eggs.	57 eggs♂died.	No egg.	No egg.
18–11–27	78 eggs.	70 eggs.	69 eggs.	No egg.	No egg.
19–11–27	45 eggs.	62 eggs.	62 eggs.	4 eggs.	2 eggs.
20–11–27	23 eggs.	40 eggs.	♀ died.	No egg.	12 eggs.
21–11–27	22 eggs.	33 eggs.	...	4 eggs.	17 eggs.
22–11–27	19 eggs.	15 eggs.	...	No egg.	10 eggs.
23–11–27	9 eggs.	2 eggs.	...	No egg.	10 eggs.
24–11–27	8 eggs.	♀ died.	...	61 eggs♂died.	12 eggs.
25–11–27	♀ died.	...	...	25 eggs.	21 eggs.
26–11–27	...	...	...	101 eggs.	9 eggs.
27–11–27	...	...	...	10 eggs.	45 eggs.
28–11–27	...	...	...	No eggs.	1 egg.
29–11–27	...	...	...	♀ died.	76 eggs.
30–11–27	...	died	...	...	No egg.
1–12–27	...	...	...	...	No egg.
2–12–27	...	...	...	...	♀ died.
	499 eggs.	327 eggs.	418 eggs.	205 eggs.	215 eggs.

TABLE III

Life-history Records.

Date.	A	B	C	D	E	F	G
22–10–27	Egg found laid.	Egg found laid.	Egg found laid.	Egg found laid.	Egg found laid.	Egg found laid.	Egg found laid.
25–10–27	Hatched.	Hatched.	Hatched.	Hatched.	Hatched.	Hatched.	Hatched.
28–10–27	I Moult.	I Moult.	I Moult.	I Moult.	I Moult.	I Moult.	I Moult.
30–10–27	II ,,	II ,,	II ,,	II ,,	II ,,	II ,,	II ,,
1–11–27	III ,,	III ,,	III ,,	III ,,	III ,,	III ,,	III ,,
3–11–27	IV ,,	IV ,,	IV ,,	IV ,,	IV ,,	IV ,,	IV ,,
5–11–27	Yellow colour.	...	Yellow colour.	...	Cocooning.	...	Yellow colour.
6–11–27	Cocooning.	Cocconing.	Cocooning.	Cocooning.	Not pupated.	Yellow colour.	Cocooning.
7–11–27	Not pupated.	Not pupated.	Pupated.	Not pupated.	Pupated.	Not pupated.	Pupated.
8–11–27	Pupated.	Pupated.	...	Pupated	...	Pupated.	
15–11–27	...	...	Emerged	Emerged	Emerged		
16–11–27	Emerged	Emerged	...	...	...	Emerged	
18–11–27	...	...	...	...	...	...	Emerged
	25 days.	25 days.	24 days.	24 days.	24 days.	25 days.	27 days.

TABLE IV

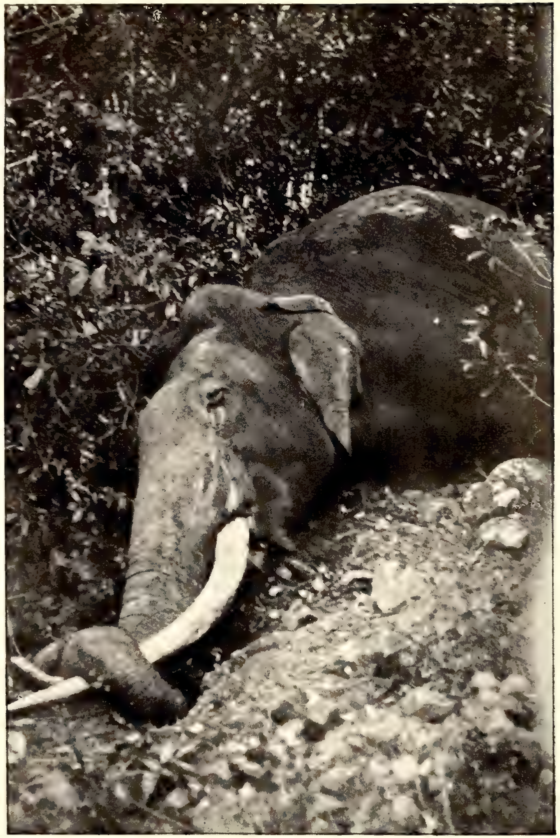
Life-history Records.

—	Eggs found laid.	Adults found emerged.	Total life-cycle.
I	21–10–27	13,14,15,16 & 18–11–27	23,24,25,26,28 days.
II	24–10–27	19,20 & 21–11–27.	26,27,28 days.
III	25–10–27	20–11–27.	26 days.
IV	26–10–27	21–11–27.	26 days.
V	15–11–27	13,14–12–27	28,29 days.
VI	16–11–27	14,15 & 16–12–27	28,29,30 days.
VII	17–11–27	15 & 16–12–27	28,29 days.
VIII	19–11–27	17–12–27	28 days.

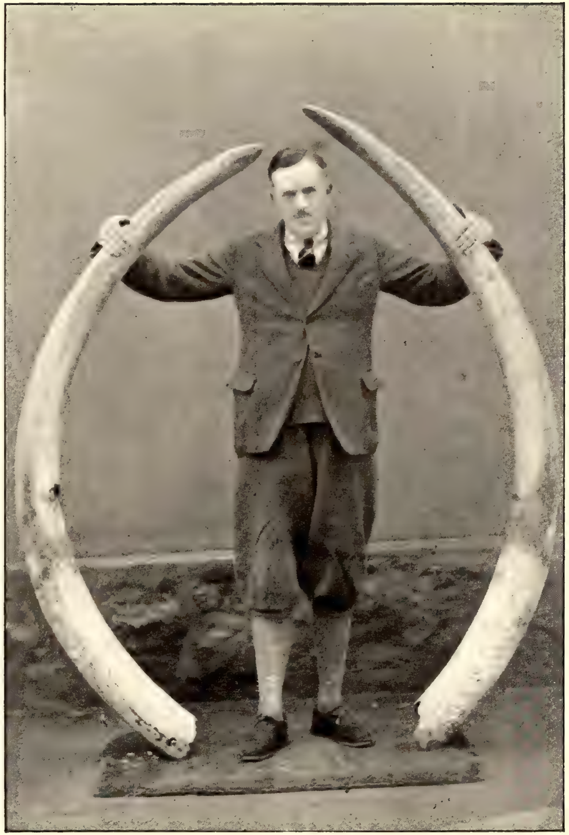
TABLE V

Longevity records of adult moth.

No.	When emerged.	When died.	Total No. of days alive.	Remarks.
1	20–10–27	♂ 5–11–27	16	Eggs laid by ♀
		♀ 26–10–27	6	
2	20–10–27	♂ & ♀ 28–10–27	8	Eggs laid by ♀
3	20–10–27	♂ 24–10–27	4	...
		♀ 2–11–27	13	
4	20–10–27	30–10–27	10	♀
5	14–11–27	1–12–27	17	
6	14–11–27	♂ 17–11–27	3	
		♀ 25–11–27	11	
7	14–11–27	24–11–27	10	♀
8	14–11–27	20–11–27	6	♀
9	15–11–27	29–11–27	14	♀
10	15–11–27	24–11–27	9	♀
11	15–11–27	25–11–27	10	♂
12	15–11–27	28–11–27	13	♂
13	15–11–27	11–12–27	26	♂
14	16–11–27	2–12–27	16	♂
15	16–11–27	21–11–27	5	♂
16	16–11–27	23–11–27	7	♀
17	18–11–27	2–12–27	14	♀



Major Gillespie's Tusker.



Major Gillespie, R.A.M.C., and his record tusks.

	Length	Weight
Left:	8′ 2″	91 lbs.
Right:	8′ 2″	90½ ,,

A FURTHER ELEPHANT SHOOT ON THE BARAGUR HILLS

BY

RANDOLPH C. MORRIS

(*With a plate*)

On the 3rd of February 1929, Lt. Col. G. E. Tallents, D.S.O., of the Lancashire Fusiliers, and Major F. S. Gillespie, R.A.M.C., both of Wellington, and I set out to bag three rogue elephants that had been proscribed in the Baragur Hills, and had been marked down in the Madeswaranmalai Reserve, in the northern part of the hills. Our shikaries and skinners had all gone a day ahead with instructions to engage pack bulls at Cowdally for our kit. Arriving at Cowdally we found the bulls awaiting us, and leaving instructions that these were to come up to Sengady Bungalow on the hills, we carried on hoping to reach there before dark. Our transport up to this point included a Chevrolet, carrying ourselves and our servants, and a Ford van containing our *saman*. Arriving at the foot of the Ghat four miles from Sengady we halted for the Ford to catch us up. After waiting for some time, there being no sign of the Ford, it was decided to motor back along the narrow road to find out what was holding it up. We did not proceed far before we met one of the men who had been travelling in the Ford with the driver and learnt from him that one of the back-wheels had collapsed and that the Ford was lying in the road three or four miles back. It was dark by the time we reached the spot and found that the van had luckily not turned over and that the bolts holding the spokes at the hub had sheared off with the result that the spokes had all come out but had not been otherwise damaged. The van was unloaded and pushed to the side of the road. The driver and one of the trackers, whom we had picked up at Cowdally, were sent to the nearest village to enlist the services of a blacksmith and in the meantime we sat down in the road and had some grub which the servants quickly prepared for us. Luckily the pack bulls turned up and we were able to leave for Sengady in the Chevrolet with our trackers standing on the running boards, leaving instructions for the servants to load up and follow with the pack bulls by a short cut. The remaining four miles to Sengady were not easy, the road being narrow, the surface none too good, and the gradient steep. However, we eventually reached the thatched Forest Rest House there without further trouble and were glad to stretch ourselves out on the floor and soon fell asleep. Our servants and pack bulls arrived just before dawn and breakfast was soon served, followed by our departure for Ponnachi, which entailed a ten mile walk. The car was left at Sengady in charge of the local Forest subordinates. Ponnachi was reached by mid-day and the rest of the day was spent in getting fresh *khubbar* of the Ponnachi rogue. An early start was made on the following morning for the village of Marrur where locals were engaged and the thick bamboo jungle scoured by our trackers and locals, in couples, for fresh traces of the rogue while we sat down to await their return. After an hour's wait two men came back with the news that they had marked down an elephant which was probably the rogue; at the same time we received *khubbar* of an elephant in another direction and as our head tracker had sent for us we decided to make for the spot where he was said to be watching the elephant. This turned out to be false news, however, as there was more than one elephant there and we could definitely see part of the herd grazing out in the open on the western face of Ponnachi Batta, the northernmost hill of the Baragurs, rising nearly 5,000 ft. in elevation. While we were watching the herd through our glasses one of their number dislodged a boulder and it rolled down the hillside into the jungle with terrific crashes terrifying the remainder of the herd below and causing them to move off rapidly trumpeting shrilly. We also saw a herd of bison passing through the thick bamboos above us, and two of our trackers had seen a bear. We then retraced our steps and lost no time in getting to the place where the other elephant had been marked down only to find that he had retired into thick cover, as the sun was now well up. Considerable time was lost by the false *khubbar* we had received. We had difficulty in getting through the extremely thick bamboo above the elephant and although we crawled down to within a few yards of the animal the cover was so dense that it hid it entirely from view. It was decided, therefore, to wait for the elephant to come out of the cover late in the afternoon, and our tiffin having arrived we retired further up the hillside for our meal. A little later we received word that the elephant had moved further down towards a nulla in which there was water, and directly our meal was finished we decided to follow it, but found to our annoyance that the elephant had evidently got our wind and vanished. The ground was very hard and the trackers were unable to make out the direction in which the elephant had gone, and the hunt finally had to be given up.

On our return to Ponnachi Bungalow a council of war was held and, as our time was limited, it was decided to make for Madeswaranmalai that night after dinner, especially as we had received news that the other two rogues had been marked down there. After our meal was over the pack bulls were loaded up and we started on a tiring ten miles tramp aided by the light of four petrol lanterns. Our pace was naturally limited to that of the pack bulls and we did not reach the spot where we proposed to camp till 2.30 a.m., thoroughly tired, and glad to turn in, which we did without delay directly our camp cots were unloaded and prepared for us out in the open. A monthly pilgrimage to the well-known temple at Madeswaranmalai occurs, and early next morning batches of pilgrims arrived, having climbed the stone paved path which we had toiled up the previous night. Our trackers had been sent out early in the morning to pick up fresh tracks of the rogues, and were told to meet us at a certain spot. We had barely reached the place when word was brought to us that one of the rogues, a crossed tusker, had been marked down. This turned out to be false *khubbar,* however, the man who brought us the news having heard langurs crashing in the bamboos and had taken it for granted that it was the elephant. However, soon after this we received definite news that the crossed tusker had been seen and was being watched and we were guided to the place. After a heavy climb we arrived at the spot where the elephant had been seen and found that it had moved on into thick cover. The wind was very treacherous and on following the tracks of the elephant through thick evergreen cover we were warned by a shrill trumpet and a crash ahead of us, that the elephant had got our wind and was getting annoyed. This brought us to a halt and we decided to give the elephant time to move off into more open jungle. On taking up the tracks a little later we found that the elephant had crossed fairly open ground towards thick bamboo jungle, and on proceeding a few yards further we again heard a crash which caused us to leap for our rifles which had been handed to our shikaries on reaching open ground. The rogue was now in a patch of extremely thick cover and we decided to get to the other side of the patch to cut it off in case the elephant intended going straight through it. By the time we had worked our way to the further side of the cover the elephant had cooled down a bit and we heard it breaking bamboos quite close to us. A long wait followed in the hope of seeing the elephant break cover in our direction and, as it was evident that it had no intention of doing this for some time, a local Forest subordinate offered with a few men to try to drive it towards us. It was decided that this was the wisest course to adopt and we stationed ourselves in the best place we could find covering its most probable line of approach. The men, however, started beating in the wrong direction and the rogue, after expressing its annoyance by crashing about in the cover for a minute or two, suddenly showed itself below us working its way through thick undergrowth across our front. Major Gillespie who had won the toss for first shot decided to take the ear-shot. It was a difficult shot as very little of the elephant could be seen and it was moving off at a good pace. The elephant fell heavily on receiving our shots (Gillespie's shot was followed by one from me) but got up again and disappeared from view with a shrill trumpet and staggering from side to side. A few seconds later we heard another trumpet and raced in that direction as hard as we could, and came on to the upper reaches of the paved Pilgrim's pathway, and found ourselves at the place where it was all too evident the elephant had crossed, for a scene of wild confusion met our eyes, broken chatties, cloths hung up on bushes, other articles dropped here and there, and one or two frightened pilgrims with scratches on their arms and legs appearing from their hiding places. It transpired that the elephant had crossed the path just when a batch of pilgrims had been coming up it. It had luckily heard the pilgrims and given vent to the second trumpet that we had heard before bursting out on the path, thus it had given time for the pilgrims to scatter, which they did so successfully that actually only two of them saw the elephant cross, the others having disappeared into the surrounding jungle like lightning, dropping everything they possessed. The line of the elephant's flight could be clearly seen as, apart from the path it had made for itself through the cover in its onrush, there was a broad and continuous trail of blood. Here we halted for a drink and for our trackers to collect. It was not long, however, before, to our surprise, we heard the elephant puffing and groaning up on the hillside behind us, proving that it had turned back and recrossed the paved path. It did not take us long to get up to it, and we found the elephant moving slowly and painfully in dense bamboo cover and it was evident that it was hard hit. The elephant soon moved down to the edge of a stream, and we cautiously approached it by another paved path, one of the features of these jungles. Suddenly the elephant got our wind and was immediately an embodiment of devilish fury. It whipped round and came back crashing through the bamboos to within a few yards of us and then halted, with curled trunk, uncertain of our exact position. The Forest Guard with us lost his head, and started wailing 'climb trees'. Major Gillespie and I fired almost simultaneously and the elephant dropped dead.

Up to now we had not had a good view of its tusks and we were, therefore, astonished and delighted to find that the rogue carried an enormous pair of tusks which were crossed near the tips. I realised at once that the tusks were a record for South India and that Major Gillespie was to be congratulated on his magnificent trophy. By a strange coincidence the elephant died a few yards off the spot we had arranged to camp on for the night, and had in fact, as could be seen from the broad trail of blood, crossed our actual camping ground. Our pack bulls and servants arrived on the spot with our kit a few minutes later. Had they turned up fifteen minutes earlier they would have run straight into the wounded rogue with possibly disastrous results.

At about 11 p.m., that night, after we had turned in, two of our trackers went down to the stream to fetch water and found another elephant beside the dead one; needless to say they hastily retreated. To our surprise next morning we found that the intruder had dragged the dead elephant from where it had fallen further towards the stream. This was most interesting as I had known of three cases previously of elephants shifting dead tuskers that had been shot, evidently with the idea of helping them to rise. Forest subordinates soon arrived on the spot to take measurements of the tusks and fore-feet. Instructions were given to our skinners to remove the tusks and both fore-feet and the tail which, however, was devoid of its much prized hairs, and we set out after the second rogue which was supposed to be near by.

It soon became evident, however, that the firing on the previous day had disturbed the other rogue and it had, in fact, been seen trecking down into the deep Yereky-gorge dividing Madeswaranmalai from Ponnachi Betta. Four trackers were sent in advance to mark down the rogue while we followed by another route. The temperature down in the gorge when we finally got down was very different. The heat was intense and there was very little shade.

We followed the tracks of an elephant or two until we met two of our trackers coming back up the valley and were informed by them that they were not the tracks of the rogue, the tracks of which they had seen further up the valley. We retraced our steps and later came on our other two trackers who had been up the side of the gorge following the tracks of the rogue which had led them back again into the main valley where for the time being the tracks were lost. We sat down in the coolest place we could find while the trackers looked round for fresh tracks of the rogue which they soon found leading up the valley. We followed these tracks till mid-day and then proceeded to a spot where we had arranged for the servants and camp kit to meet us, and here we had our lunch and a rest while the trackers went on ahead. It was late in the afternoon when word was brought to us that the tracks had led to thick bamboo cover where the trackers thought the elephant was probably standing. This was good news, but we were doomed to disappointment, as, after searching the whole of the head of the valley, we could find no traces of the elephant nor could we see where the tracks led to. We decided to renew our search for the rogue the next morning and returned to the river bed where we were to camp. Our water was none too good, taken from two or three pools in the sand, and this had to be boiled well.

Up to noon of the following day our hunt for the rogue proved fruitless and we were delighted to receive news at about 2 p.m., that the rogue had been marked down in a deep ravine higher up on the slopes of Madeswaranmalai and it was apparent that the brute had not wasted its time in the hot and steamy gorge but had climbed back to its old haunts. This necessitated a very arduous climb in the hottest part of the day and we were considerably hot and exhausted by the time we reached the spot where our good tracker was watching the elephant, from the opposite side of the ravine. The wind was blowing up and we had to cross up to the head of the valley to work our way round to the other side above the elephant so as not to give it our wind. We then had to work our way carefully down towards the elephant and this was not easy as the steep slope was covered with loose stones, several of which we dislodged and with difficulty prevented from rolling down the slope and thus giving ourselves away. We finally took up a good position but the elephant was feeding in such thick cover that although we were within a few yards of it its head could not be seen at all. There was nothing for it but to wait in the hope that the elephant would move into a better position and we realised with anxiety that the sun had set and that only half an hour's good shooting light could be relied upon. Suddenly the wind changed, the elephant stopped feeding, and its trunk could be seen 'taking the wind'. After a moment's hesitation the elephant swung round giving a magnificent view of its head. Col. Tallents, taking careful aim, gave the elephant the right barrel of his ·577 cordite rifle followed by one from Major Gillespie. It was obvious that both bullets found their mark in the elephant's brain, and that the shots from my rifle were really unnecessary as the elephant collapsed on receiving the first two bullets. I say '*shots*' from my rifle as although I intended to fire only one barrel both barrels went off simultaneously on my pressing the front trigger. The shock, both to my feelings and to my shoulder, was considerable, as the recoil of a ·450 cordite rifle with both barrels going off at the same time, is something to be remembered. The elephant proved to be a magnificent specimen, larger in body than Major Gillespie's crossed tusker. Its tusks were not so long as those of Major Gillespie's rogue but were very thick. News was sent up to the skinner and we wended our way back down the bed of the rocky ravine to the valley below. This took us two or three hours, the going was extremely bad and tiring, the mantle of the petrol lantern had collapsed and we had to light our way with bamboo torches which had to be renewed every half hour. We finally reached our camp at about 9 p.m., tired but well pleased with our good luck.

We found that news had in the meantime come in that the third rogue had been marked down at Ponnachi near the village of Marrur; and it seemed likely that we would emulate the exploits of the three elephant hunters who had killed three rogues on Madeswaranmalai in 1926 in two days. I was a member of the party on that memorable trip and had the luck to bag a magnificent crossed tusker which had made a most unprovoked attack on us. We set out early on the following morning to climb up to Ponnachi, and although we started out in very good time it was very hot and muggy, which made the climb up out of the gorge tiring and uncomfortable, and we were very glad to sit down at last in the shade near the village of Marrur at the foot of Ponnachi Betta (hill). The villages of Ponnachi and Marrur are blessed with a few scattered cocoanut palms and we were soon quenching our thirst with green cocoanuts. After a rest we moved on to the village of Marrur and here we waited under the shade of a tamarind tree for fresh news of the rogue marked down on the previous day. It was not till 3 p.m., that our head tracker who had gone out after the elephant with two locals returned with the news that the elephant had left the cover it had been last seen in, and had trecked down northwards along the eastern slope of Ponnachi Betta, which towered above us, and had gone down to the Cauvery river which, miles away, flowed down a deep valley to the North and North-east of Ponnachi Betta. The news was disappointing, especially to me as this was to be my elephant. We returned to Ponnachi Bungalow and after a discussion it was decided to spend the next day in a long tramp the whole way round Ponnachi Betta as there was just a possibility that, by doing so, we might come upon the rogue working its way back up the valley to the West of Ponnachi Betta. We started out early next morning and tramped to the south-western foot of Ponnachi Betta and then along its western slopes. For a time the going was good but the ground later got worse as the grass was long and the slope covered with loose stones and we frequently had to pass through tangled masses of dead bamboos; and it was noon before we found ourselves at the northern end of Ponnachi Betta overlooking the

Cauvery river which could be seen below us like a silvery streak on a wide expanse of sand showing that there was very little water in the river. On our way we had seen a cow elephant and a calf on the opposite side of the valley. We found that there were no other elephants in the valley and it seemed likely that the cow and the calf had got separated from the portion of the herd that had scattered on a boulder being rolled down on them by the rest of the herd grazing above a few days before. Working our way to the north-eastern side of the hill we sat down for lunch while Bommah, our head tracker, and two locals descended to the valley at the eastern foot of the hill to take up the elephant tracks, and we were asked to follow directly we had finished our meal as Bommah was certain of picking up the tracks down in the valley. Here again the going was exceedingly bad and the temperature down the valley very different from that up the hillside, in fact it was like a furnace and to our disgust we found that Bommah could find no traces of the elephant whatever, and we learnt from herdsmen who were grazing their cattle in the valley that they were quite sure no elephant had come down the valley within the last few days. Curses were now showered on Bommah's head as it was quite apparent that he had simply taken it for granted that the elephant had descended the eastern slopes of Ponnachi Betta, believing the assurances of the two locals who were with him to this effect.

We now had to climb up to the top of Ponnachi Betta which meant climbing from 1,000 feet to nearly 5,000 feet and a very steep climb at that. There was no time to waste and we started off on the high ascent, and the higher we climbed the further away the summit seemed to be, and to make things more difficult and uncomfortable for us a large part of the climb was through grass far above our heads. Eventually we found ourselves at a spring, not far below the ridge and here we refreshed ourselves before tackling the last bit which finally brought us to the top of the mountain. The panoramic view from the top of this hill was amazing and is certainly the best I have ever seen. To the west and south-west could be seen the Nilgiris and the Billigirirangans, to the south of us stretched the Baragurs, the northernmost and highest peak of which we were now on, and to the north lay seemingly endless stretches of small valleys and foot-hills; and to the east could be seen the long stretches of the Cauvery until it disappeared from view round a ridge, and beyond it the plains up to the Shevaroys, the Kwollimallais, and the Pacchaimallais, and to the south-east endless stretches of plains. The sun had set and we had to hurry, especially as we had no lantern with us, and we were faced with a walk of about eight miles in darkness back to the Ponnachi Bungalow, including a descent down the western side of the hill along a rough and stony path. We passed through the evergreen shola of Ponnachi from North to South and by the time we had reached its southernmost limit it was quite dark. By luck we found a length of dry bamboo and, using this as a torch, we slowly made our way downhill picking up on our way another piece of bamboo which also served as a torch when the first one had burnt out, and this lasted us till we reached thick bamboo jungle near the foot of the hill and here we got ample material for torches, and eventually reached Ponnachi Bungalow at mid-night. Early the next morning our kit was all packed up and loaded on the pack bulls. We let the bulls get ahead of us and then started on our eight mile tramp down to the cars. We finally got back to the Estate late in the afternoon.

The Ponnachi rogue did not live for long after this as Mr. A. S. Vernay and I went after it again recently, and after marching on its tracks for two days from Ponnachi down into the valley where we had left the cars and up to Madeswaranmalai, we finally came up to the rogue in thickish cover, not far from where we had come on Gillespie's elephant. The tusker was in high grass and was not in a good position when Vernay decided to take his shot. The first two shots missed the brain and the elephant charged and was brought down at the fourth shot.

Thus died the last elephant proscribed for the present on the Baragur Hills. Another was shot by Lt.-Col. R. E. Wright, C.I.E., I.M.S., of Madras, just before Christmas near Tattakerai on the Baragur Hills, this elephant and a man-eater being the chief objects of our trip at the time. The tusks of this elephant weighed 40 lbs. each, and their length each 6′ 2″.

Dimensions of Tusks.—

Major Gillespie's Elephant.—

	Length	Weight
Left Tusk	8′ 2″	91 lbs.
Right Tusk	8′ 2″	90½ lbs.

Lt. Col. Tallent's Elephant.—

	Length	Weight
Left Tusk	5′ 8¼″	55½ lbs.
Right Tusk	5′ 9″	58½ lbs.

MOSSES OF THE BOMBAY PRESIDENCY, THE HIGH WAVY MOUNTAIN AND MT. ABU.

BY

E. BLATTER.

The mosses mentioned in the following list were collected by K. R. Kirtikar, G. M. Woodrow, R. M. Maxwell, G. A. Gammie, L. J. Sedgwick and E. Blatter. All the work was done during the last 25–30 years in an area stretching from Bombay to N. Kanara along the Konkan and the W. Ghats and a narrow strip at the eastern foot of the W. Ghats. Not one specimen is known from that part of the Presidency which lies N. of Bombay. A vast field for further investigations.

The time has not yet come for any geographical considerations regarding the distribution of Bombay mosses. There are a few localities fairly well explored: Khandala, Mahableshwar and Panchgani, and a few stretches in N. Kanara ; but of the rest of the W. Ghats, the Deccan and the S. M. Country we know practically nothing. Of the Konkan only Bombay Island and Salsette are known to some extent. South of Bombay and right down to Goa we are quite ignorant regarding the moss-flora.

Almost everybody could, without much trouble and difficulty, contribute to the further exploration of the country. Removing a handful of moss from a tree or rock and wrapping it up in a piece of newspaper with the locality and the date written on it, does not require much exertion. No drying and changing of paper is needed.

For the benefit of those who are not satisfied with gathering mosses, but are anxious to know something about them, a list of literature on mosses of India and adjacent countries is appended.

Nearly all the specimens mentioned were named by H. N. Dixon, some by Cardot and Brotherus.

At the end two short lists of mosses are added, one from the High Wavy Mountain and another from Mt. Abu. All the lists are, for practical reasons, arranged alphabetically.

MOSSES OF THE BOMBAY PRESIDENCY.

Anæctangium stracheyanum Mitt.
Locality : Deccan ; On earth banks, Purandhar (Sedgwick).—*W. Ghats :* Panchgani (Blatter 386).

Anæctangium Walkeri Broth.
Locality : W. Ghats : On stones, Panchgani (Sedgwick).

Anomobryum brachymenioides Dix. *sp. nov.*
Locality : W. Ghats : Panchgani (Blatter 387).

Anomobryum cymbifolium Broth.—*Bryum filiforme* Mitt.
Locality : W. Ghats : On stones and trees, Mahableshwar, Panchgani, Lonavla, Trimbakeshwar (Sedgwick), Khandala, on the ground (Blatter).

Archidium birmannicum Mitt.
Locality : Kanara : Karwar, rocks on hill-side (Sedgwick 6383), Jog, rock on open hill (Sedgwick 6477).

Aulacopilum abbreviatum Mitt.
Locality : W. Ghats : Panchgani (Blatter 381). New to S. India (Dixon).

Barbella rufifolia (Thw. & Mitt.) Broth.
Locality : N. Kanara : Siddapur, hanging from trees (Sedgwick 6488).

Barbula comosa Dz. & Mb.
Locality : W. Ghats : On rocks, Khandala (Blatter).

Barbula consanguinea (Thw. & Mitt.) Jaeg.
Locality : Deccan : On tiles in the Ganeshkhind Botanical Garden (Sedgwick).

Barbula consanguinea (Thw. & Mitt.) Jaeg. *forma* Dix.
Locality : N. Kanara : Shiggaon, bole of coconut palm, spice gardens (Sedgwick 3487).

Barbula dharwarensis Dix.
Locality : S. M. Country : Nigadi, Dharwar District, earth-bank in compound of rest-house (Sedgwick 5703).

Barbula indica (Hook.) Brid. *forma* **sterilis** Fleisch.
Locality : N. Kanara : Sampkhand, on a wall (Sedgwick 6432).

Brachymenium acuminatum Harv.
Locality : W. Ghats : Mahableshwar (Blatter 372) ; Panchgani (Blatter 394). New to S. India (Dixon).

Brachymenium exile (Dz. & Mb.) Bry. jav.
Locality : Deccan : Earthy banks, Purandhar (Sedgwick 126).

Brachymenium longifolium Dix. *sp. nov.*
Locality : W. Ghats : Khandala (Blatter).

Brachymenium nepalense Hook.
Locality : W. Ghats : On walls, Lonavla (Sedgwick).

Brachymenium pectinideum Card.
Locality : W. Ghats : Khandala, on rocks and trees (Blatter).

Brachymenium turgidum Broth. & Dix.—Dixon in Revue Bryologique 35, année (1908) 94.
Locality : W. Ghats : On timber of a bridge, Lonavla, branches of a *Euphorbia*, Lonavla, on trees at Lonavla and Trimbakeshwar (Sedgwick), Lonavla and Matheran (Kirtikar), on trees, Khandala (Blatter), Mahableshwar (Blatter 378).—*Deccan :* On trees and *Euphorbia* bushes, abundant, Purandhar (Sedgwick).

Brachymenium turgidum Broth. & Dix. *var.* **nanum** Dix.
Locality : S. M. Country : Tadas, Dharwar District, on mango, Konankeri, on bark of *Ixora parviflora*, near Dharwar, on mango trees (Sedgwick 5373, 3509, 3591).

Brachymenium Walkeri Broth.
Locality : W. Ghats : On stones, Panchgani (Sedgwick).

Bryosedgwickia Kirtikarii Card & Dix.
Locality : W. Ghats : Mahableshwar (Blatter 369, 370), Panchgani (Blatter 382).—*N. Kanara :* Castle Rock, near Goa (Gammie, Sedgwick 138).

Bryum apalodictyoides C. M.
Locality : W. Ghats : Mahableshwar (Blatter).

Bryum argenteum L. *var.* **australe** Rehm.
Locality : N. Kanara : Shiggaon, on a wall (Sedgwick 3486).

Bryum coronatum Schwaeg.
Locality : Very common, almost everywhere (Sedgwick).—*Konkan:* Bombay (Blatter).—*Deccan :* Poona (Woodrow).—*N. Kanara* (Sedgwick).

Bryum Ghatense Broth. & Dix.
Locality : W. Ghats : On a small bridge at Lonavla and Mahableshwar, apparently always in sunny places and associated with *Funaria hygrometrica* (Sedgwick).

Bryum sahyadrense Card. & Dix.
Locality : Deccan : In crevices of a stone wall, Purandhar (Sedgwick 134).

Bryum sp.
Locality : Konkan : Bombay (Blatter 366).

Bryum strigosum Wils.—*B. Wightii* Mitt.
Locality : W. Ghats : Mahableshwar (Woodrow, Kirtikar, Sedgwick).—*Deccan :* Satara (Sedgwick 139).

Calymperes Fordii Besch.
Locality : Konkan : On tree trunks, Andheri (Sedgwick).—*N. Kanara :* Siddhapur, decayed tree trunk (Sedgwick 6486).

Calymperes Nietneri C. M. *var.* **atro-viride** Dix.
Locality : N. Kanara: Siddhapur, on tree (Sedgwick 6482).

Calymperes tortelloides Broth. & Dix.
Locality : W. Ghats: On trees, Mahableshwar (Sedgwick).

Campylopus aureus v. d. B. & Lac.
Locality : W. Ghats: Mahableshwar, on the ground (Woodrow, Sedgwick).

Campylopus Goughii (Mitt.) Jaeg.
Locality : W. Ghats: Mahableshwar, on rotten wood of trees (Sedgwick), Panchgani (Blatter 397, *forma*).

Campylopus laetus (Mitt.) Jaeg.—*Dicranum laetum* Mitt. Musci Ind. Or. 19.
Locality : W. Ghats: Mahableshwar (Sedgwick 39).

Campylopus Sedgwickii Card. & Dix.
Locality : W. Ghats: Mahableshwar, common on the ground in open places (Sedgwick).

Colliocostella papillata (Mont.) Jaeg. *forma* **purpurascens** Dix.
Locality : N. Kanara : Sampkhand, on stone in stream (Sedgwick 6439)

Ctenidium stereodontoides, Dix.
Locality : N. Kanara : Sampkhand, on stones in stream (Sedgwick 6445).

Diaphanodon procumbens (C.M.) Ren. & Card.
Locality : W. Ghats : Khandala, on trees (Blatter 356),

Diaphanodon procumbens (C. M.) Ren & Card. *forma* **flagellifera** Dix.
Locality: W. Ghats : Mahableshwar (Blatter 359, 360, 362 & 363 type form), Panchgani (Blatter 385).—*N. Kanara :* (Sedgwick).

Dicranella divaricata (Mitt.) Jaeg.
Locality : W. Ghats : Panchgani (Blatter).

Didymodon rufescens (Hook.) Broth.
Locality : Deccan : On stones, Purandhar (Sedgwick).

Ectropothecium compressifolium (Mitt.) Jaeg.
Locality : N. Kanara : Rocks by a small waterfall, 1,400 ft. alt., rainfall 150 in. (Sedgwick 6450).

Ectropothecium cyperoides (Hook.) Jaeg.—*Stereodon cyperoides* (Hook.) Mitt. Musci Ind. Or. 99.
Locality : N. Kanara (Sedgwick).

Entodon plicatus C. M.
Locality : S. M. Country : Anmod, on trees (Sedgwick 3308).—*W. Ghats.* Lingmala near Mahableshwar, on trees (Sedgwick 4664).

Entodon plicatus C. M. *var.* **dimorphophyllus** Dix. *et* P. de la V.
Locality : W. Ghats : On trees, Sakhar Pathar near Lonavla (Gammie 101).

Erpodium mangiferæ C. M.
Locality : Konkan : On the bark of a jackfruit tree, Ghatkopar (Sedgwick).—*Deccan :* Close growing on the bark of smooth trees, Satara (Sedgwick 141).

Fissidens crenulatus Mitt.
Locality : W. Ghats : On earth-banks, Mahableshwar (Sedgwick).

Fissidens diversifolius Mitt. Musci Ind. Or. 140.
Locality : Deccan : On an earth-bank in the Krishna River, Walva, Satara District (Sedgwick).—*Konkan :* On an earth-bank in a torrent course, Waishakare, Thana District (Sedgwick).
These specimens were first put under *Fissidens Walkeri* Broth. by Dixon in Journ. Bot. (1909) 158. The correction was made by the same writer in Rec. Bot. Surv. Ind. vi (1914) 77.

Fissidens immutatus Dix.
Locality : N. Kanara : Karwar, on earth-bank (Sedgwick 6380), Sirsī, earth-bank in evergreen (Sedgwick).

Fissidens karwarensis Dix.
Locality : N. Kanara : Karwar, on stones (Sedgwick 6368), bole of coconut palm in irrigated spice garden at Shiggaon (Sedgwick 3485.)

Fissidens macrosporus Dix.
Locality : N. Kanara : Gersoppa Falls, on twigs of trees in very wet evergreen (Sedgwick 6463).

Fissidens Sedgwickii Broth. & Dix.
Locality : W. Ghats : On stones of the stream above Dhobi's Waterfall, Mahableshwar (Sedgwick), Panchgani (Blatter 400).—*N. Kanara :* Castle Rock, on stones in forest (Sedgwick 3417).

Fissidens splachnobryoides Broth.—Dixon in Journ. Bot. vol. 47, May 1909.
Locality : Konkan : Thana (Sedgwick).—*Deccan :* On stones at Trimbakeshwar, Nasik District (Sedgwick).

Fissidens subfirmus Dix.
Locality : S. M. Country : Anmod (Sedgwick 3266, 5375).

Fissidens Walkeri Broth.
Locality : S. M. Country : Anmod, earth-bank of stream (Sedgwick 3265).—*N. Kanara :* Sampkhand, stone in stream (Sedgwick 6436), Sirsi, earth-bank in evergreen (Sedgwick 6449).

Fissidens Walkeri Broth. *var.* **elimbatus** (Broth.) Dix.—*F. elimbatus* Broth. in Rec. Bot. Surv. Ind. i (1899), 316.
Locality : N. Kanara : Tinai Ghat, Castle Rock (Sedgwick 3262).

Fissidens zippelianus, Dz. & Molk.
Locality : Deccan : Poona, on a wall (Sedgwick).—*W. Ghats :* Mahableshwar (Blatter 367).—*N. Kanara :* Karwar, on stones (Sedgwick 6376), Guddahalli Hill, Karwar, on stones in stream in dense evergreen (Sedgwick, 6399), Sampkhand, stones in stream (Sedgwick 6448).

Fissidens Zollingeri Mont.
Locality : Mirjan, on rotten earth inside a tree (Sedgwick 6414).

Funaria calvescens Schid. *forma* (*F. connivens C. M.*).
Locality : Deccan : Poona, on rocks (Blatter).

Funaria hygrometrica Sibth.
Locality : Deccan : Poona, very common (Woodrow).—*W. Ghats :* Mahableshwar (Kirtikar), Lonavla, Mahableshwar, always on sunny walls (Sedgwick).

'Some of the gatherings approach the forms which have been called *F. leptoda* Griff and *F. nepalense* C. M., but these are probably inconstant and local variations from the type.' (Sedgwick).

Gymnostomiilum vernicosum (Hook.) Fl.
Locality : Konkan : On a wall, Thana (Sedgwick), on damp rocks, Vehar Lake (Blatter), on chunam walls, Bombay (Kirtikar).

Hymenostomum edentulum (Mitt.) Besch.
Locality : W. Ghats : On stones, Panchgani (Sedgwick).—*Deccan :* On banks, Purandhar (Sedgwick), Konankeri, on *Ixora parviflora* (Sedgwick 3510).

Hymenostylium xanthocarcum (Hook.) Brid.
Locality : W. Ghats : Damp ground, Mahableshwar (Kirtikar).—*Deccan :* On earth-bank, Purandhar (Sedgwick).

Hyophila involuta (Hook.) Jaeg.—*Gymnostomum involutum* Hook., Musc. Exot. (1820) t. 154.—*Gymnostomum cylindricum* Hook. in Lond. Journ. Bot. (1840) 2.—*Hyophila cylindrica* Jaeg. Adumbr. I, 204.—*Hyophila stenocarpa* Ren. & Card. in Bull. Soc. Roy. Bot. Belg. (1899) 218.
Locality : W. Ghats : Lonavla, Mahableshwar (Kirtikar), on basalt rock, Khandala (Blatter), Mahableshwar, Panchgani, Trimbakeshwar (Sedgwick).—*N. Kanara* (Sedgwick).—*Deccan :* Poona, very common (Woodrow).

Hyophila stenocarpa Ren. & Card.
Locality : W. Ghats : Khandala, on rocks (Blatter).

Hyophila subflaccida Broth. & Dix.
Locality: Konkan : On chunam walls, Andheri (Kirtikar).—*Deccan :* On tiles of a roof, Satara (Sedgwick 142).

Hyophila Walkeri Broth.
Locality : N. Kanara : Karwar, on stones (Sedgwick 6366).

Hyophilopsis entosthodonatacea Card. & Dix.
Locality : Deccan : Purandhar (Sedgwick).—*W. Ghats :* Panchgani, on earthenware pot (Blatter 393).

Lepidopilum rhaphidostegium (C.M.). Broth.
Locality : N. Kanara : Gersoppa Falls, on twigs of tree in very wet evergreen (Sedgwick 6464).

Leucoloma Renauldii Broth.
Locality: N. Kanara : Jog, stem of tree (Sedgwick 6468).

Leucoloma sarcotrichum C.M.
Locality : W. Ghats : On trees, Khandala (Blatter).

Leucoloma strictifolium Dix.
Locality : N Kanara : Sampkhand, on *Calophyllum* (Sedgwick 6444).

Leucoloma Walkeri Broth.
Locality : N. Kanara : Sampkhand, on stem of *Calophyllum inophyllum* (Sedgwick 6443).

Leucomium aneurodiction (C.M.) Jaeg.
Localtiy: S.M. Country : Dharwar District, growing with *Vesicularia Levieri* (Sedgwick 7279 b).

Levierella fabroniacea C.M.
Locality : W. Ghats : On trees, Trimbakeshwar (Sedgwick), Panchgani (Blatter 389).

Levierella fabroniacea *var.* **dilatatinerve** Card & Dix.
'*Robustior, folia majora, costa valida, ad 50 μ lata juxta basin, dimidiam partem versus raptim attenuata, nonnunquam furcata.*' Card & Dix.
Locality : W. Ghats : On wall in loose mats growing downwards, Purandhar (Sedgwick 132).

Macromitrium ellipticum Hampe.
Locality : W. Ghats : On trees, Khandala (Blatter).

Macromitrium neelgheriense C.M.
Locality: W. Ghats : Mahableshwar (Blatter 366).

Macromitrium subleptocarpum Dix. *sp. nov.*
'*M. leptocarpo Broth. ghetensi affine ; theca autem et seta multo breviore, minore, folisque majoribus, latioribus.*' (Dixon).
Locality : W. Ghats : Mahableshwar (Blatter 376, 379).

Macromitrium sulcatum Brid.
Locality : W. Ghats : On trees very common, Mahableshwar and Panchgani (Sedgwick), Matheran and Mahableshwar (Kirtikar).—*Deccan :* Poona (Woodrow).—*N. Kanara* (Maxwell, Sedgwick).

Mercevopsis pellucida Broth. & Dix.
Locality : W. Ghats : On the roof of a cave and under stone ledges, Panchgani (Sedgwick).

Meteoriopsis squarrosa (Hook.) Fleisch.
Locality : W. Ghats : On trees, Mahableshwar (Kirtikar and Sedgwick).

Neckera andamana C. M.
Locality : N. Kanara : On trees (Maxwell).

Neckeropsis andamana (C. M.) Fleisch.
Locality : N. Kanara : Siddhapur, on sapling (Sedgwick 6484).

Octoblepharum albidum Hedw.
Locality : Konkan : Ratnagiri (Woodrow), Matheran (Kirtikar), Khairne, Thana, on a toddy palm (Sedgwick).—*W. Ghats :* Khandala, on trees (Blatter).—*N. Kanara* (Sedgwick).

Orthomnium subscrispum (C. M.)
Locality : W. Ghats : On a tree, Mahableshwar (Sedgwick).

Oxyrrhynchium prælongum (Hedw.) Broth.
Locality : Deccan : Poona (Woodrow 8).

Philonotis angusta Mitt ?
Almost identical with the Ceylon species described by Fleischer under that name and distributed in Musci Arch. Ind. no. 178.
Locality : Konkan : Kanheri Caves (Salsette) on the ground (Blatter).

Philonotis mollis (Dz. & Molk.) Bry. jav.
Locality : W. Ghats : Panchgani (Blatter 391).—*N. Kanara :* Sampkhand, on stone in a stream (Sedgwick 6435), Malamane Ghat, earth-bank (Sedgwick 6473), Siddhapur, on bank in shade (Sedgwick).

Philonotis revoluta, v. d. B. & Lac.
Locality : W. Ghats : Mahableshwar, common (Kirtikar and Sedgwick), Trimbakeshwar, Lonavla, Panchgani (Sedgwick).

Pilopogon Blumii (Dz. & Mb.) Broth.
Locality : Deccan : Purandhar, on earth-banks (Sedgwick).

Pinnatella calcuttensis (C. M.) Fleisch.
Locality : W. Ghats : Mahableshwar (Kirtikar, Sedgwick, Blatter 365).—*N. Kanara :* (Sedgwick).

Pinnatella limbata Dix.
Locality : N. Kanara : Sampkhand, rocks in stream (Sedgwick 6437).

Pogonatum aloides P. Beauv.
Locality : W. Ghats : Mahableshwar, on banks (Woodrow, Sedgwick).—*N. Kanara :* (Sedgwick).

Pterobryopsis Maxwellii Card. & Dix.
Locality : W. Ghats : On trees, Mahableshwar (Sedgwick).—*N. Kanara :* On trees and rocks (Maxwell), Sampkhand, rocks in stream (Sedgwick 6433, 6434), Guddahalli, Karwar, trees on exposed hill summit (Sedgwick 6388), Gersoppa Falls, twigs in very wet evergreen (Sedgwick 6466), Castle Rock, on trees (Sedgwick 5516, 5518, 5519).—*S. M. Country :* Anmod, on trees (Sedgwick 3310, 3311, 5376).

Pterobryopsis Walkeri Broth.—*P. Kanarense* H. N. Dixon in Journ. Bot. vol. 47 (1909) 163.
Locality : N. Kanara : On stones (Maxwell), on trees, Guddahalli Hill, Karwar, on exposed rock (Sedgwick 5521).—*W. Ghats :* Mahableshwar (Sedgwick), Khandala, on trees (Blatter), Sakhar Pathar, Lonavla (Gammie).

Rhynchostegium vagans (Harv.) Jaeg.
Locality : W. Ghats : Mahableshwar (Blatter 374).

Splachnobryum indicum Hampe & C. M.
Locality : Konkan : On flower-pots, Thana (Sedgwick).

Stereophyllum anceps Broth.
Locality : W. Ghats : Mahableshwar (Blatter 373, Sedgwick 4759).—*N. Kanara :* Konankeri, bark of *Ixora* (Sedgwick 3507).

Stereophyllum Blatteri Card.
Locality : W. Ghats : On trees, Khandala (Blatter), on bark of *Thespesia populnea*, Matheran (Kirtikar).

Stereophyllum ligulatum *var.* **Sedgwickii** Broth. & Dix.
'*Perrobustum ; caulis ad 5-8 cm. longus, vage ramosus, folia magna, ad 2·25 mm. longa, 1 mm. lata, concava. elliptica, obtusa vel subobtusa, integra vel interdum ad summum apicem crenulata* (Broth. & Dix.).
Locality : W. Ghats : On a tree, Panchgani (Sedgwick 48).

Stereophyllum ligulatum (C. M.) Jaeg.—*Hypnum ligulatum* C. M.—*Englossophyllum ligulatum*, C. M.
Locality : W. Ghats : On trees at Mahableshwar, Panchagani, Purandhar (Sedgwick), Panchgani (Blatter).

Stereophyllum tavoyense (Hook.) Jaeg.
Locality : Konkan : On tree, Wasind, Thana District (Sedgwick).

Symphyodon angustatus (C. M.) Jaeg.
Locality : W. Ghats : On trees, Mahableshwar (Sedgwick),

Symphyodon Perrottetii Mont. *forma* **myuroclada** Dix.
Locality : S. M. Country : Anmod, on trees (Sedgwick 3263).—*N. Kanara :* Sampkhand, on bole of *Calophyllum* (Sedgwick 6442).—*W. Ghats :* Mahableshwar (Sedgwick 4750, 4761).

Syrrhopodon semiliber (Mitt.) Besch.
Locality : N. Kanara : Siddhapur, twigs of trees (Sedgwick 6440).

Taxithelium (*Anastigma*) **vivicolor** Broth & Dix.
Locality : W. Ghats : On stones in the bed of a torrent, Mahableshwar (Sedgwick).

Taxithelium nepalense (Harv.) Jaeg.
Locality : N. Kanara : Guddahalli, Karwar (Sedgwick 6402), Sampkhand, on stones in stream (Sedgwick 6451).—*S. M. Country :* Anmod, on stones and trees (Sedgwick 3422, 3264).

Thuidium trachopodum (Mitt.) Bry. jav.
Locality : N. Kanara : Guddahalli Hill, Karwar, stones in stream in dense evergreen (Sedgwick 6400), Jog, on stones in stream (Sedgwick 6470).

Trachopodiopsis blanda (Mitt.) Fleisch.
Locality : Deccan : On trees, common, Poona (Woodrow).—*W. Ghats :* Matheran and Mahableshwar (Kirtikar), Lonavla, Trimbakeshwar, Mahableshwar (Sedgwick.)

Trachyphyllum inflexum (Harv.) Gepp.
Locality : N. Kanara : Shiggaon, on bole of coconut palm in irrigated spice gardens (Sedgwick 3484), Konankeri, on bark of tree (Sedgwick 3518).

Trematodon Schmidii C. M.
Locality : W. Ghats : Panchgani (Blatter 399).

Trichostelium monostictum (Thw. & Mitt.) Broth.—*Sematophyllum monostictum* Thw. & Mitt.
Locality : W. Ghats : On tree-roots, Mahableshwar (Sedgwick).

Trichostelium monostictum *var.* **laevius** Dix.
'*Papillae foliorum multo minores, indistinctæ.*' Dixon.
Locality : W. Ghats : In dense mats on the roots of trees, Mahableshwar (Sedgwick 21).—*N. Kanara :* Samkhand, bark of fallen tree (Sedgwick 6441).

Trichostomum hyalinoblastum Broth.
Locality : W. Ghats : Panchgani (Blatter 398).

Trichostomum stenophyllum Mitt.
Locality : W. Ghats : On trees, Mahableshwar (Sedgwick).

Urocladium alopecuroides Hook.
Locality : W. Ghats : On trees, Khandala (Blatter).

Vesicularia Levieri Card.
Locality : S. M. Country : Dharwar (Sedgwick 7279).

Weisia ghatensis Dix. *sp. nov.*
Locality : W Ghats : Panchgani (Blatter 392).

MOSSES OF THE HIGH WAVY MOUNTAIN.

Aerolryum Willisii Fleisch.—No. 311.—Hitherto found in Ceylon only.

Barbella enervis (Thw. & Mitt.) Fleisch.—No. 307, 326.

Bryum argenteum L.—No. 330.

Bryum strigosum Wils.—No. 302, 404.

Campylopus erythrognaphalus (C. M.) Jaeg.—No. 301.

Campylopus comosus (Reinw. & Hornsch.) Bry. jav.—No. 400.

Dicranoloma leucophyllum (Hampe) Par.—No. 319.—New to India proper.—*Distribution :* Ceylon, Malaya, etc.

Entodon plicatus C. M.—No. 318.

Floribundaria sparsa (Mitt.) Fleisch.—No. 306.

Himantocladium rugulosum (Mitt.) Fleisch.—No. 323b, 324.

Homaliodendron javanicum (C. M.) Fleisch.—No. 316.

Hyophila involuta (Hook.) Jaeg.—No. 303, 308.

Leucobryum javense (Brid.) Mitt.—No. 320.—New to India proper.

Leucoloma nitens (Thw. & Mitt.) Par.—No. 312.

Macromitrium ceylanicum Mitt.—313.

Macromitrium sulcatum Brid.—No. 304, 305.

Macrothamniella pilosula (Mitt.) Fleisch.—No. 315.

Meteoriopsis squarrosa (Hook.) Fleisch.—No. 323a.

Papillaria fuscescens (Hook.) Jaeg. *forma*.—No. 331.

Pogonatum Neesii (C. M.) Mitt.—No. 400.

Pterobryopsis cavifolia Dix. *sp. nov.*—'A distinct new species, but there were only a scrap or two of it, and it is hardly in sufficient quantity to publish' (Dixon).—No. 403.

Rhizogonium spiniforme (L). Bruch, *forma foliis angustissimis* Dix. No. 322.

Symphyodon praemollis Dix. *sp. nov.*—'This genus is not quite certain ; but it is certainly new.' (Dixon).—No. 321.

Thuidium cymbifolium (Dz. & Molk.) Bry. jav.—No. 332.

Trachyloma tahitense Besch.—No. 405.—New to India proper. Found in Ceylon.

Trichostomum cylindricum Bruch.—No. 309.

Regarding this collection which I made on the High Wavy Mt. (Madura District) in 1917, Mr. Dixon writes in epistula. 'The mosses from the High Wavy Mt. are interesting, not because there is much new, but because, for the small number of species there is rather a large proportion which have not been found on the Indian mainland, but have been gathered in Ceylon, which is what one might expect from the geographical position, but which is interesting to have demonstrated.'

MOSSES OF MT. ABU.

These mosses which I collected in 1916 and 1917, are growing in the deciduous forests of that hill-top which reaches from between 4,000 and 5,600 feet high.

Brachymenium acuminatum Harv.—No. 347.

Brachymenium exile (Dz. & Molk.) Bry. jav.—No. 342.

Bryum. *sp.*—No. 343, 351, 352.

Fissidens Schmidii C. M.—No. 340.

Funaria hygrometrica (L.) Sibth.—No. 341, 346.

Homomallium simlaense (Mitt.) Broth.— No. 353.

Hyophila involuta (Hook.) Par.—No. 367.

Hyophila involuta (Hook.) Par. *f.* **elata**.—No. 367.

Pottia vernicosa (Hook.) Hpe.—No. 345.

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THE LIFE OF A MEALY-BUG (*MONOPHLEBUS STEBBINGI*)

BY

MAJOR R. W. G. HINGSTON

(*With one plate and three text figures*)

This is a very notable insect. Its large size, its conspicuous white colour, its mealy covering, its almost vegetable inertness make it appear quite out of the ordinary. This alone ought to be sufficient to justify some observations on its life.

GENERAL HABITS

What is it like? (Fig. 1). First the female, an uninteresting looking object. We see before us a flattened lump, ovoid, wingless, about two-thirds of an inch long. Superficially she looks devoid of structure. She might be just a white excrescence on the tree. Examining her closely, we find she is segmented. Her body is marked with transverse rings and is clothed in a white powdery skin. From her head end small antennae jut out, and underneath her are tag-like legs. Inert, stuck to one spot, just occasionally crawling from one place to another, she spends her time sucking at the sap, an apparently devitalized lump.

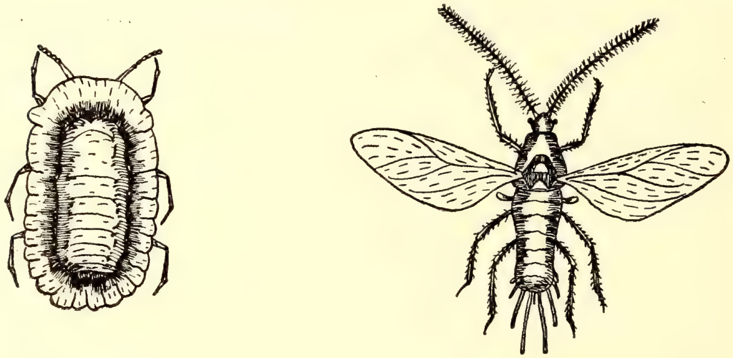

Female Male

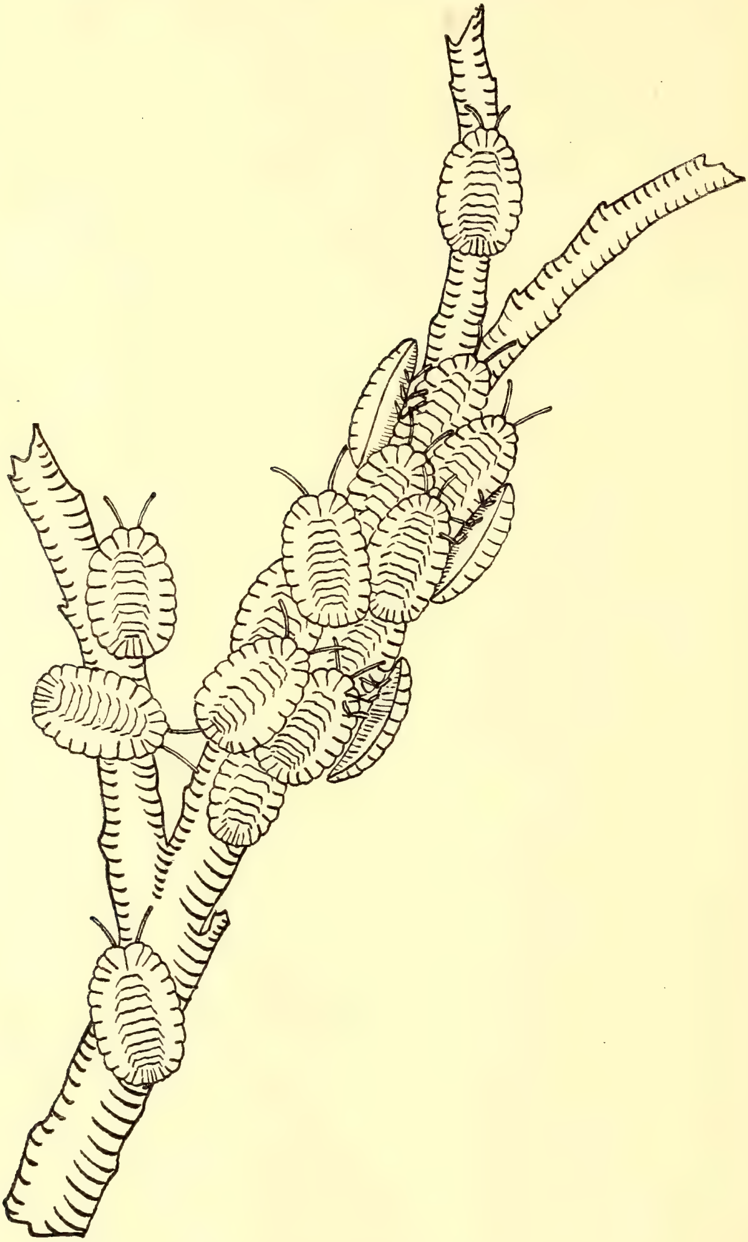
FIG. 1.—A MEALY-BUG. (*Monophlebus stebbingi*) x 4.

Now for the male. See how different he is. Here we have an active, winged individual. He flies about, full of activity, and might easily be mistaken for some species of moth. His body is bright red, his wings slate blue. More conspicuous still are his remarkable antennae, slender filaments, as long as himself, and furnished throughout their whole length with a multitude of radiating hairs.

Many trees harbour these injurious pests. I find them in thousands on the Mango and Tamarind; less numerous on the Banyan,

Journ., Bombay Nat. Hist. Soc.

THE LIFE OF A MEALY BUG (*MONOPHLEBUS*)



MONOPHLEBUS CLUSTERED ROUND A STEM

the Pipal, the Gular, and other kinds of wild fig. In Central India during May and June the trees in question are thickly infected. Crowds of lumps embrace the stems, a sluggish multitude that to all appearances is a lifeless heap (Plate). But what are they in reality? A voracious ring, a deadly pest that is sucking out the life blood from the plant. Overlapping one another as imbricated flakes, they draw up the sap through their pointed beaks and shoot it out at their posterior ends. Like drops of rain it falls on the foliage which glistens as if moistened with dew. From time to time they cast their skins. The lump first anchors itself by its beak. Then its skin splits along the middle line from the head to about half way down the back. Through this slit in the integument the lump crawls out, while the cast off skins stick to the foliage as if they were flakes of snow.

I notice the males in March and April. They search the branches, looking for females prepared to accept them as a mate. Of course they come on females in abundance. In those months the trees are literally thronged with them, especially round the bases of the flowers or imbricated along the stalks. The male visits successive clusters, going steadily from flake to flake, stroking each with his antennary brushes till he comes on one prepared to mate. The nuptials are unexciting. There is no demonstration. Even the fulfilment of these vital functions causes no enthusiasm in the female lump. The male just squeezes in between the female and the stem, and consummation follows in its course.

Let us see what these lumps do in the world. Their chief business is to suck up sap. For hours their beaks remain stuck in the stems. The liquid they shoot out—the altered sap—is a clear sweet viscid substance, which varnishes the underlying leaves. Many other kinds of insects come in search of it. The social wasps are persistent visitors. Honey-bees too are particularly fond of it and suck it up from where it varnishes the leaves. They know well where it comes from; for they visit the clustered lumps as if they were so many flowers. Ants have gone one better than the bees. All the bees do is pay a visit to the lumps and gather up the good things that fall. The ants remain with and

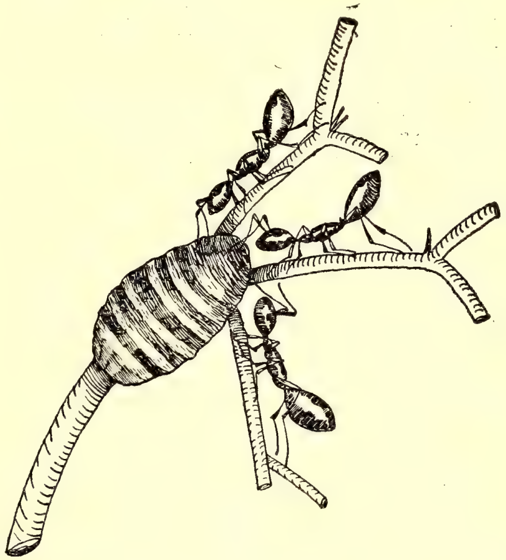


FIG. 2.—MONOPHLEBUS ATTENDED BY BLACK ANTS.

protect the lumps. Moreover they know how to get the liquid out. It is common to see the Black Ants, *Camponotus compressus,* persistently milking the liquid from these bugs. Four or five ants will collect round one of them, and commence to stroke it gently with their antennae (Fig. 2). A drop of liquid will ooze up from its posterior, and this the ants eagerly drink. Also the ants well know when the bug is able to supply them with liquid. For they never stroke it when it is on the move; only when it is absolutely motionless with its beak stuck in the stem. It is strange that the Red Ants, *Œcophylla smaragdina,* take no notice of this valuable food. These ants well know the business of cattle-milking. They tend *Lecanium, Icerya, Aphis,* but they seem always to ignore *Monophlebus.* Sometimes we see a tree covered with Red Ants, and at the same time supporting myriads of these lumps. What a harvest the latter would have been to Black Ants. But the Red Ants pay them not the slightest attention. Their valuable secretion accumulates in drops and rains down on the leaves underneath.

Thus we see what these lumps do in the world. They drain out sap and devitalize vegetation. They shoot out fluid to feed other insects, and keep in existence a multitude of ants. Not at all a small niche in the scheme of things for creatures that look nothing but inanimate flakes.

Have these creatures any enemies? Certainly they have one, *Aulis vestita,* a small brown ladybird-like beetle which eats into the tissues of the bug and sucks out its yellow juice. Also a parasitic wasp lays eggs in them. I have seen the little enemy alighting on their backs. I doubt if they are ever attacked by birds. Though very conspicuous, they are well protected through being filled with a disgusting juice. Squeeze one of these lumps. Its tense skin bursts and out comes a spurt of viscid juice, yellow, slimy, creamy, pungent, a disgusting yolk-of-egg kind of stuff. It is this which renders the lumps immune. I have sometimes thrown one to a swarm of ants. They attack it, tear its integument. Out comes the slime. The ants get smeared with it. Their jaws get clogged; later they begin to stagger as if dosed with some narcotic drug. Thus the lumps are protected by their narcotising contents. Any enemies they might have will quickly learn that these are mere bags of stupefying slime.

SPECIAL SENSES

It is worth inquiring into their senses. What can these bags of disgusting juice know of the outside world? Can they see? They seem to possess a trace of eyes, just the very minutest specks fixed on the under surface of their heads. Perhaps they possess some trace of vision, though experiment makes me believe them to be blind. I move things about just in front of their heads. The lumps are not in the slightest disturbed by it. They certainly do not see the objects. I doubt if they have any perception of light. Can they smell? I test them with my usual series of drugs. I spray a solution of camphor round their beaks. Nothing happens. I try oil of eucalyptus, a stronger smelling substance, smearing it around and underneath their bodies. I even envelop them in a film of the oil. Nevertheless they remain undisturbed. Smell is just as deficient as sight. And, after all, what good would it be to them? What is the use of an olfactory sense to creatures which live with their beaks in a stem? Can they hear? I fire a collecting-gun at six inches from a cluster. There is so much shock in addition to sound that their stem quivers from the report. But the lumps take not the slightest notice. Hearing is no better than sight and smell. Can they taste? Here is something we might expect of them. The lumps live on trees of different kinds. The saps of these trees must have different tastes, and the lumps may have to tell the good from the bad. I paint some quinine solution on a stem. It flows round about their beaks. I expect it to soak into the stem and give a bitter flavour to the sap. The ruse is successful. After a few minutes the lumps get uneasy. Some of them draw out their beaks and transfer themselvse to less bitter ground. So they do seem to possess something, a moderate sense of taste. Can they feel? Of course they can. Feeling, at least in some primitive form, is coexistent with life itself. I stroke them with a needle. They shrink and contract. They certainly feel the attacks of *Aulis,* and are sensitive to the blandishments of their males. Also they perceive the strokings of ants; no doubt it gives them some pleasant sensation, for they shoot out fluid in return. They are also sensitive to a parasitic fly which I have seen alighting on their backs. When it touches them they raise their abdomens and sometimes forcibly spurt out juice.

Taste and touch! These constitute all their sensual life. Such is the equipment a creature needs in order to keep sucking juice from a stem. No hearing, no sight, no smell! How little can they know of the vast world of sentient living things. Here we have something like senseless automata just growing, gorging and swelling on sap. Why, they are little better than the tissues of those plants which they so persistently devour.

Being deprived of such primitive avenues of sensation, is it not amazing how their lives run in a steady and unerring stream? For their lives are by no means altogether uncomplicated. These creatures have before them definite migrations, and disaster will follow if they make mistakes. When a certain season comes they must ascend a tree, when another season comes they must descend to the soil. How do they do it? Not by their senses, so much is certain. But rather by that innate instinctive knowledge which guides their actions with unfailing precision.

MIGRATIONS

Let us inquire into that knowledge. But first we must see why and where they migrate.

We will watch the multitude spread through a mango tree. Throughout March they have been steadily sucking. By April they are glutted to satisfaction, and the clusters then begin to break up. Each lump crawls slowly along the branch, reaches the trunk, climbs down it, and gets to the ground underneath. All begin moving at about the same time. A multitude of sluggish lumps go crawling down to earth. On reaching the ground they seem a bit confused, and at first accumulate in an aimless manner around the foot of the tree. By the end of April the descent is over. All the white clusters have disappeared. Just a scattering of white exuviae on the foliage tells where these pests have been.

For the rest of the year we see no more of them. Where have they gone to? Into crevices and sheltered nooks round about the outskirts of the tree. Then what happens? In these sheltered nooks they lay eggs, hundreds gathered into heaps. The female shrinks under the process. As the reddish coloured eggs pour from her she gradually loses strength and vitality. In the end she dies. All that remains is a shrivelled flake lying by the side of the eggs.

The eggs hatch out at the end of the year. The youngsters commence their life amidst the debris. There they moult, then climb up on the low-lying vegetation and get sap wherever they can. For two or three months they keep near the ground. Then they feel the call to ascend and begin to stream towards the tree.

In March I see them moving to the mango. This is the month when the tree is in blossom. Sap swells its leaves and stems, and the half-starved migrants are eager for its juice. How well fitted are the events of Nature. The date of the migration is timed exactly with that of the maximum of fluid in the tree. The migration is fascinating. Undeveloped, shrunk and collapsed, the immature lumps crawl inward to the trunk. Their advance is slow and very laborious. They cannot do much on such tag-like legs. Obstacles of every kind confront them. Yet they either climb over or make their way round them, and in the end get to the trunk. The males too appear amongst the migrants; they may even offer courtship and attempt to mate. The stream, where thick, makes a striking spectacle. We see thousands of moving flakes all advancing in a dogged manner straight towards the base of the tree. They reach the trunk. Then comes the ascent. Up they go, not without some difficulty. Some of them slip and come tumbling to the ground. These ones, however, soon recover, and again begin the climb. The procession continues till all are aloft. By the end of the month the branches are thronged. Thousands of beaks are buried in the sap, and the shrunken snow-flakes begin to swell into distended lumps.

Now comes the point of interest. What guides these creatures in their journey to the tree? How do they find their way across the soil direct to the base of the trunk? Once they reach that particular point, then the rest is easy enough. Their natural instinct to climb upward will carry them to the topmost shoots. But how is it that they do not go astray as they converge towards the tree-trunk? For they do not just wander about fortuitously. Rather they converge in undeviating lines as though each well knew the direction it should go in. Yet how do they know it? Not through sight, nor hearing, nor smell. We have seen what they are, almost vegetable flakes that can feel and have some sense of taste. How can such creatures keep a course direct to the foot of a particular tree. One would think that such an act demanded mentality. Yet what mentality have these senseless lumps? No path, nothing to guide them, their course is through grass and leaves and debris, a trackless and encumbered waste. Nor, like ants, do they follow one another; each has to shape its individual course.

Let us try an experiment or two with them. I turn one about and make it face backwards. It twists back to its normal course. I put a branch before another, dig a trench before a third. They cross the obstacles and march on. I move them about in different directions. One I push forward about six inches, another I bring back about the same distance. At first they are confused and lose their bearings, but soon they get back to their original course. I even lie down in the midst of the stream. Over me climbs the multitude which streams on towards the tree.

How do they do it? Without sight, without smell, without landmarks, without track, without any previous memory or experience, they stream in from all directions and unfailingly reach the foot of the tree. I fall back on a belief in some unknown sense, in that capacity to feel direction which many creatures seem to possess. How do locusts cross wide arms of the ocean? How do butterflies cross the Himalayan ranges? How do dung-beetles roll their pellets in straight undeviating lines? All I can say is that they feel their direction in some manner inexplicable to us. ...

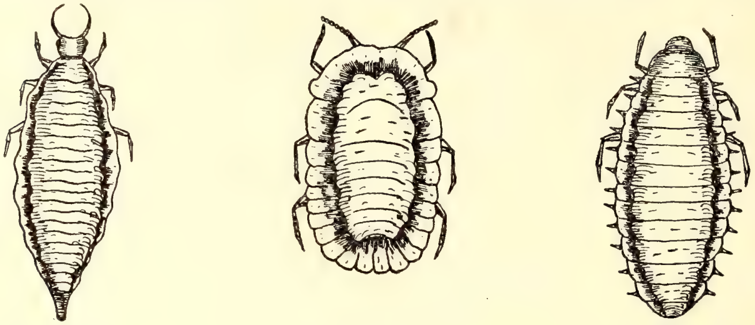
So it must be with *Monophlebus*. Though little more than senseless lumps, yet they have their full share of that inherited knowledge, the innate, intuitive, impulsive force which we ordinarily call instinct. It is this instinct of direction which guides them to the tree-trunk, after which the instinct to climb in the vertical brings them up to the leaves. These instincts have been born with them, have been fixed and strengthened and rendered infallible by inheritance through countless years. The parents of these migrants made the same journey; for generations the converging and ascending habit has gone on in the same routine. Of course this provides no explanation to their guidance. But it tells us that the knowledge is innate and inherited. These flakes have the impulse to follow a course. That impulse has been born with them, it is part of themselves, and unconsciously they obey its demands.

MIMICS

Their migrations, we have seen, give us cause for reflection. But there is still a more interesting point.

We may stand for half an hour beneath the tree and watch the continual flow of flakes without dreaming for a moment that all is not in order, that the flakes are not all of an identical type. But if we stop to examine minutely we will notice small differences amongst the flakes; and then, when we go into the matter in detail, we shall find that we are dealing not with *Monophlebus* only, but with three totally different creatures clothed in a somewhat similar dress (Fig. 4).

The first is *Monophlebus*. We have seen what she is. The second is the larva of *Aulis vestita*, that beetle which persistently attacks the lumps. Sometimes we may find it in considerable numbers, perhaps one to fifty or sixty of the flakes. They crawl about sluggishly, on both tree and ground, where they intermingle with the *Monophlebus* stream. Now see the resemblance between larva and lump. In the field, owing to both being covered with white powder, the resemblance is much closer than can be shown in a sketch. Its size is that of a migrating *Monophlebus;* its body, though more elongated, is somewhat the same shape; it is transversely segmented, has a sinuous margin, and moves on tag-like legs. Its body too is covered with powder, like the meal on the *Monophlebus* lump. Also its movements are distinctly lump-like, just a slow and steady crawl.



Hemerobiid larva X4

Monophlebus, female X4

Aulis vestita, larva X4

Fig. 3.—Monophlebus and her Mimics.

Now, why this resemblance, a clear case of mimicry, Where is the advantage to the beetle grub in being dressed like one of these lumps? First, is it an aggressive mimicry? Certainly we might think so. For *Aulis,* both larva and adult beetle, is a persistent enemy of these lumps. Will not the mimicry aid its depredations by allowing it to more easily approach its prey? Not at all. *Monophlebus* possesses no power of resistance. Why, it cannot even perceive its attacker. The lumps are equally open to destruction no matter in what guise the enemy should come. Hence the mimicry is not an aggressive one. Let us turn the problem the other way up.

Is it a protective mimicry? Can the larva carry out its depredations with more safety because it is lost in the midst of the lumps? Almost certainly it can. We have seen how very well protected is *Monophlebus*. Pinch one, and out comes a burst of slime, a nauseous, offensive, narcotic juice. Because of this juice scarcely anything attacks them. Birds and lizards completely ignore them as they wander carelessly up the bark. Even ants, which carry off almost everything, studiously neglect this distasteful prey. Obviously then the *Aulis* is protected by being mistaken for the horrible lumps. The wolf has dressed itself in sheep's clothing and in this way escapes being devoured.

It is interesting to follow the fate of this mimic. It attacks *Monophlebus,* eats into its interior, gluts itself on the yellow juice. Bloated with the slime, it changes to a pupa. Then it fixes itself to the bark, often still enveloped in its victim's skin. But later on this covering drops off, leaving the bare pupa attached to the tree.

Now for the third inhabitant of the stream. Here we have another example of mimicry. We discover an altogether different creature, this time the larva of a Hemerobiid, one of those delicate lace-wing insects that belong to the heterogeneous order, Neuroptera. Here then we have quite another kind of mimic, one related to the dragon-flies and ant-lions. It walks about amongst the lumps and cannot be easily distinguished from them. In size, shape, annulated body, tag-like legs, powdery integument, we find a fairly close agreement in the surface appearance of Hemerobiid and bug. Also their movements are practically identical, and they occupy the same haunts. This larva, however, is more slender than *Aulis;* also it has the same habit of pushing itself forward with its tail. Hemerobiid too is out for plunder. I have seen it attacking the winged males and sucking out their juice. Hence in its case the mimicry is probably aggressive. The males are active. They visit the females, and no doubt at times they visit Hemerobiid, mistaking it for one of their opposite sex. This gives the Hemerobiid a chance to make a grab. Again we have a wolf in sheep's clothing; and the males walk into the wolf's jaws. Indeed, I expect that in this second case the mimicry fulfils a double purpose. It is both an aggressive and protective mimicry. For Hemerobiid, like *Aulis*, must gain protection through its resemblance to this nauseous bug.

Two other points strike me in this instance of mimicry. One is the remoteness of relationship between these creatures. *Monophlebus* is a bug. *Aulis* is a beetle. Hemerobiid is a family of Lace-Wing Flies. We could scarcely get three insects more widely separated. Yet here we find them resembling one another, only, of course, a superficial similarity, as it were, a kind of camouflage for offensive or defensive ends.

The other point refers to the web of life. It is striking that the lives of these different creatures are interwoven with respect to time. *Monophlebus* becomes active at a certain time and streams up into the tree. Now the time of its activity is dependent on the tree. In March the stream climbs into the Mango; not till June do I see it making for the Tamarind. Why is this? Why do these different arboreal streams become active at different months? Because in these months the trees are in blossom, the Mango in March, the Tamarind in June; and it is then that they are bursting with sap. Thus we see how the awakening of the lumps fits in with the flowering of particular trees. Similarly do the mimics fit in with the lumps. They make their appearance when the lumps are in migration. Why? Because that is the time which suits their depredations. It is then that their mimicry can be effective. It is then that they can capture and destroy. Thus mimics and lumps and trees are interdependent. The mimics kill the lumps; the lumps rob the tree. But all this would fail were time not considered. The bug must come out when the tree is swollen; the mimics must come out when the bugs are on the move. The threads in the web of life are well adjusted. Nature has ordained that these separate activities should each fit in one with the other, and that each should come into active operation at its proper place and time.

A NOTE ON THE BUTTERFLIES AND HAWK-MOTHS OF KATHIAWAR

(*With special reference to the Bhavnagar State.*)

BY

LIEUT.-COL. A. H. MOSSE, I.A., F.Z.S.

Alike in the Society's Journal and in the usual text-books, any mention of the not inconsiderable Province of Kathiawar, as a locality for *Lapidoptera*, is conspicuous by its absence. A note on the results of some two years' recent collecting therein will therefore, I hope, be of interest.

As was to be expected, the butterflies found are mainly those of North Gujarat, though perhaps the most interesting find is that of the occurrence on the western shore of the Gulf of Cambay of the desert species *Arphritis* (*Aphnæus*) *acamas hypargyros*, not hitherto recorded, I believe, south of Cutch. The Gir Jungles of Junagadh, which I have not had the opportunity of working, may produce a few additional species, otherwise, although my collecting has been almost entirely confined to the Bhavnagar State, in the south-east of the Province, I do not think many additions to my list of the regular inhabitants of Kathiawar are very probable. I have adopted the order and nomenclature of Evans' recent work. As regards Moths, I have attempted to deal only with the *Sphingidæ*.

BUTTERFLIES

PAPILIONIDÆ.

1. *Byasa aristolochiæ*. Abundant, especially in July, October and February but to be seen almost the whole year round. I have estimated the numbers feeding, one October morning, on the flowers of antigonon along a palisade some sixty yards in length, at not less than 400—a delightful spectacle. The habit of this butterfly of feeding especially in the morning and evening is well known, but it may often be seen at flowers at any time of day. I know no other butterfly which keeps such long hours : I have not infrequently met with it on the wing before the sun was up and again have watched it at dusk on the blossoms of a flowering tree, loth to bring its supper to an end, long after the hawk-moths were out. I may mention a male specimen, taken in November, in which the white discal markings of the hind wing are centred with pink.

2. *Papilio polytes*. Fairly common. The *romulus* form of female, while scarcer than the *polytes* form, is not infrequently found, although *B. hector*, which it mimics, does not occur. I have bred a couple of males of the *cyrus* form in which the submarginal lunules of the hind wing underside are large and of a deep red, those in spaces 1, 2 and 4 being reproduced, though smaller, on the *upper* side. These were cold weather specimens. It is remarkable what small eaters the larvæ of this species are and how slow their growth in the cold weather, just as much so in a state of nature as in captivity. One individual, hatched from the egg on 18th December, did not attain the pupal stage until 8th February. It sometimes feeds, like the larva of *P. demoleus*, upon lime, but the favourite food plant is the shrub known as the 'curry nim' which *P. demoleus*, in my experience, does not affect.

3. *Papilio demoleus*. Abundant, on the wing most months of the year.

4. *Pathysa nomius*. In May 1928, observed at close quarters, though I did not succeed in taking it, an undoubted specimen of this species, in a fruit garden at Mahuva on the sea coast, some sixty miles S. by W. of Bhavnagar.

5. *Zetides agamemnon*. Fairly common at Mahuva but not seen in Bhavnagar. I have taken it at Rajkot. The tails in Kathiawar specimens are long.

PIERIDÆ.

6. *Delias eucharis*. All over Kathiawar where there are good sized trees but nowhere common. Frequents flowering trees, especially in February, not often seen in the monsoon.

7. *Belenois mesentina*. Very common.

8. *Huphina nerissa*. Common, but less widely distributed than No. 7. Marked variation between W. S. and D. S. forms.

9. *Appias libythea*. Local in distribution, but not rare, though nowhere numerous. The males are given to hovering about the food plant, which I take to be a species of caper, upon which I have also found the larvæ of *B. mesentina* and *Colotis fausta*. The females almost invariably have the upper portion of the abdomen red, as noted by the late Col. Macpherson of Mt. Abu specimens: this is the colour of the abdomen itself, which is bare of scales, and fades in preserved specimens. In the only female which I have bred, the colour of the abdomen on first emergence was green ; unfortunately this specimen was accidentally destroyed the same day, so I cannot say whether the green would have changed to red.

10. *Catopsilia crocale*. Common, larvae on *Cassia fistula*.

11. *Catopsilia pomona*. Comparatively scarce in Bhavnagar, less so at Mahuva. I have not met with the *var. catilla.*

12. *Catopsilia pyranthe*. Abundant, especially June to August.

13. *Catopsilia florella*. Common, especially in October. I have some observations to make on the question of the maintenance of specific distinction between this and the last named species but these had better be reserved for a separate note which will follow this one.

14. *Terias libythea*. Somewhat rare. The few specimens that I have come across have been between October and March.

15. *Terias venata*. Common from end of June to September : none in the dry season.

16. *Terias laeta*. Common. Found from mid-September to early June. I have recently, in a separate note, described my discovery of the larvæ of this and the last species and discussed the probability – which I believe to be a definite fact—of their being seasonal variations of a single species.

17. *Terias hecabe*. Very common. In Kathiawar I find the underside markings of monsoon specimens are never rust coloured but always blackish as they often are in the dry season also. The usual variations occasionally occur in a diminution of and change of shape in the black markings of forewing and absence of one or both of the cell spots on underside of forewing ; one specimen is practically devoid of any markings beneath. One male, taken at Mahuva, has the ground colour a very pale clear yellow, almost cream colour.

18. *Ixias marianne*. Common. The pre-apical orange patch enters the cell in male DSF as well as WSF specimens. In female DSF the black bordering the orange patch on the inner side is completely interrupted between veins 2 and 4—as in var. *nola*—and in some specimens, both D and WSF, there is a decided yellow suffusion over the ground colour.

19. *Ixias pyrene*. Common at Mahuva. I have seen it at Kundla, not far from the eastern borders of the Gir, but nowhere else in the Province. Female always, in my experience, of the white form.

20. *Colotis amata*. Common. I watched a female ovipositing on the underside of a leaf of *Salvadora persica*. She took about eight minutes to lay four eggs, then flew round the plant, returning to the same spot after three or four minutes to make further additions to her prospective family. Have not come across the white form of female.

21. *Colotis vestalis*. Local in distribution and not common.

22. *Colotis fausta fausta*. Fairly common. Normal female of a definitely more orange colour than the pinker tint of the male. Some specimens (female only) approach the *fulvia* form in having the black apical area of the upper forewing more or less enclosed and nearly reaching to tornus. Three females taken of the white form with more or less salmon effusion, in all these the black apical area extends to tornus.

23. *Colotis etrida*. Very common, varies considerably in size.

24. *Colotis danae*. Common in places, but not so generally distributed as *etrida*.

DANAIDÆ.

25. *Danais limniace*. Fairly common.

26. *Danais plexippus*. Common.

27. *Danais chrysippus*. Abundant, to be seen all the year round.

D. chrysippus var. *alcippoides*. 3 specimens taken in Bhavnagar.

D. chrysippus var. *dorippus*. 5 specimens taken in Bhavnagar and Mahuva and one in Rajkot.

28. *Euplœa core*. Rare in 1927, fairly common in 1928.

SATYRIDÆ.

29. *Ypthima asterope mahratta*. Common.

30. *Melanitis leda*. Common.

NYMPHALIDÆ.

31. *Charaxes fabius*. Local. Have taken it at Bhavnagar, Mahuva and Rajkot, imbibing exudations from the branches of certain trees—orange, acacia and ' dhak '.

32. *Euthalia nais*. Rare. I have only found it in two places in the Bhavnagar State, frequenting dry stony stream-beds in hilly country.

33. *Hypolimnas misippus*. Very common.

Hypolimnas misippus var. *inaria* (♀). Four specimens taken at Bhavnagar and Mahuva and one at Wadhwan.

34. *Hypolimnas bolina*. Common. I took one interesting female ' deformity ' in which the right forewing was considerably smaller than the left, although in itself perfectly proportioned.

35. *Precis hierta*. Very common.

36. *Precis orithya*. Very common.

37. *Precis lemonias*. Very common.

The larvæ of *hierta* and *lemonias* are very much alike and feed on the same plant, but the former is distinguishable by iridescent blue specks at the base of the spines—a point which I have not seen mentioned in descriptions I have read.

38. *Precis almana*. Fairly common, but much less abundant than the three above.

39. *Precis iphita*. A single specimen at Kuda on the coast, twenty miles south of Bhavnagar, seen but not taken. I fancy this must have been a wind-blown wanderer, I have never seen another in Kathiawar or North Gujarat.

40. *Vanessa cardui*. Common.

41. *Argynis hyperbius hyperbius*. A single male taken and another seen in February 1929 at Kundla, near the western border of Bhavnagar State. I do not know if there is any previous record of this species south of Mount Abu, until the *castetsi* form is met with in South India ; but I may mention that a number of years ago I saw several females one monsoon at Sadra, thirty miles north of Ahmedabad.

42. *Atella phalanta*. Met with now and then, but not common.

43. *Byblia ilithyia*. Common.

44. *Ergolis ariadne*. Fairly common in Bhavnagar, but much less generally distributed than No. 43 although it shares the same food plant.

45. *Telchinia violæ*. Fairly common in Bhavnagar in 1927, less so in 1928. It may be observed that this is certainly not a district of heavy rainfall though Bingham appears to think this species is confined to such.

LYCÆNIDÆ.

46. *Castalius rosimon*. A single specimen taken at Mahuva in February 1928.

47. *Tarucus theophrastus*. Very common.

48. *Euchrysops cnejus*. Very common, especially in the monsoon.

49. *Euchrysops contracta*. Common

50. *Everes parrhasius*. Several specimens taken at Mahuva, rare elsewhere.

51. *Chilades laius* Common wherever there are lime trees.

52. *Zizera trochilus putli*. Fairly common.

53. *Zizera lysimon.* Fairly common.

54. *Zizera gaika.* Very common.

55. *Zizera otis.* Very common.

56. *Syntarucus plinius.* Common.

57. *Catachrysops strabo.* Rare in the monsoon, not uncommon in some places in the dry season, but I have never seen it in any numbers.

58. *Nacaduba nora.* A single specimen at Rajkot in December 1927.

59. *Jamides bochus.* Not rare in dry season when its cheery brilliancy attracts attention.

60. *Azanus ubaldus.* Common.

61. *Azanus jesous.* Fairly common about babul trees in the Victoria Park at Bhavnagar during the monsoon.

62. *Curetis thetis.* Five specimens of female taken at different seasons at Mahuva. I have not come across a single male.

63. *Apharitis acamas hypargyros.* Two specimens taken in November 1928 and five more in March 1929 on sand dunes on the coast at Kuda near Bhavnagar. As already remarked, this is much farther south than any previous record, so far as I am aware.

64. *Spindasis vulcanus.* Common. Monsoon females have the tornal orange patch of hind wing upperside extended to form a marginal band of varying completeness.

65. *Sindasis ictis.* Common at Mahuva, less so elsewhere.

66. *Virachola isocrates.* Not uncommon where there are pomegranate trees. Is attracted by lucerne.

67. *Rapala melampus.* Not common.

HESPERIDÆ

68. *Hasora alexis.* Found in some numbers on a flowering tree on the eastern borders of the Gir in August 1928 ; otherwise rather rare.

69. *Badamia exclamationis.* A few specimens in 1928, none seen in 1927.

70. *Sarangesa sati.* One specimen taken and another seen in Bhavnagar.

71. *Hesperia galba.* Fairly common.

72. *Suastus gremius.* Not rare in dry season.

73. *Udaspes folus.* A single specimen at Mahuva in February 1928.

74. *Padraona dara.* Bhavnagar, not common.

75. *Baoris mathias.* Common.

76. *Baoris zelleri colaca.* Fairly common.

77. *One species not identified.* Two specimens in March 1929, Bhavnagar.

78. *One Lycænid not identified,* taken at Kuda in March 1929.

HAWK-MOTHS

SPHINGIDÆ

1. *Acherontia styx.* Common. The abdominal stripe which Hampson describes as grey or grey-blue is a very definite blue in Western India specimens of this and the following species. The larva, which I have found on several plants and shrubs, notably on '*til*', has, in the later stages, pronounced blue stripes above the oblique lateral yellow ones—the latter are white in the earlier stages—and is therefore not to be distinguished from the larva of *A. lachesis* by absence of the former, as stated by Hampson. A brown form occurs not infrequently. The egg is small for the size of the moth.

2. *Acherontia lachesis.* I have bred a single specimen from a larva found at Rajkot.

3. *Polyptychus dentatus.* Common. The colouring of the larva, described by Hampson, occurs, but in the normal form the back is of a uniform bright green, with no touch of pink or yellow, the sides a paler dull green, and the oblique side stripes indistinct. An interesting feature is the prolongation of the head to a conspicuous point above, in the intermediate stages only ; this does not exist before the first moult and disappears again in the last stage.

4. *Leucophlebia emittens.* One specimen taken at Mahuva and a second at Wadhwan. Hampson's remark as to the dusky brown of the type specimen being due to discolouration is, I think, mistaken, as, in my Mahuva specimen, the magenta pink of the Wadhwan example is replaced by a dark brownish purple on the upperside.

3. *Clanis* (*Ambulyx*) sp. In the year 1919 I bred a moth at Rajkot which I sent to the Society with a description of the larva: this was forwarded to Mr. Bell who pronounced it a new species akin to *Clanis phalaris*. I should be interested to know what became of this specimen and whether it was ever named[1] or identified. I never succeeded in obtaining another.

6. *Chœrocampa alecto*. Not uncommon at Rajkot and Bhavnagar. Hampson's description of the larva is incorrect as regards Kathiawar specimens, in that the ocelli succeeding a larger one on the fourth somite are of equal size and do not decrease posteriorly; the centres of these ocelli have a mauve patch above the green. It feeds, along with the larvæ of *celerio*, *butus* and *oldenlandiæ* on a vine-like creeper with rough surfaced leaves which is common in prickly-pear hedges; also found on the grape-vine, as are *celerio* and *butus*. A form of the larva occurs in which the ground colour, instead of being green, varies from pink to brownish purple.

7. *Cærocampa theylia*. Very common.

8. *Cærocampa celerio*. Common. *Vide* my note on the larva in vol. xv of the *Journal*, page 133: the description there given holds good in Kathiawar.

9. *Cærocampa oldenlandiæ*. Fairly common, but less so than the last two; it does not appear to come to flowers so freely as they do. One of its food plants is the common garden balsam.

10. *Cærocampa butus*. Not uncommon.

11. *Daphnis nerii*. Common. I bred three abnormal specimens at Rajkot in 1926 in which there was a marked deficiency, not of pigment, but of the usual coloured scales. This was specially so on the forewings which were consequently almost devoid of the normal green colouring and of markings, with the result of a dull brown and semi-transparent effect. I deduce some hereditary defect as all three emerged on the same day from the pupae of larvæ taken together and presumably belonged to a single brood, while others bred at the same time and under the same conditions were quite normal.

12. *Dilephila livornica*. Not uncommon at Bhavnagar, rarer at Rajkot.

13. *Protoparce convolvuli*. Common.

14. *Pseudosphinx discistriga*. Common. The larva feeds on two of the same plants as *Acherontia styx* which it resembles in the early stages. But conversely to the case of *A. styx*, the oblique side stripes—there is no blue—change from yellow in the penultimate to white in the final stage; the horn at the tail, also, though crenulate, does not curl like that of *Acherontia*.

15. *Nephele hespera*. Common.

16. *Macroglossa gyrans*. Common.

17. *Macroglossa belis*. Mahuva, not common.

18. *Cephonodes hylas*. Not uncommon.

In connection with larvæ of the *Sphingidæ*, has any explanation ever been suggested of the frequent occurrence in some species of a brown form where the normal ground colour is green? This phenomenon is perhaps most often found in *Chœrocampa*, but it occurs also in *Acherontia* and *Protoparce* and probably others. In the English *C. elpenor* the young green caterpillar may be found by day on the young leaves of willow-herb at the top of the plant, while in the later brown stages it is said usually to prefer resting near the root by day, emerging only to feed at night. Thus its colouring would seem to change in conformity with its habits. But this does not apply to the *Chœrocampidæ* or to *Acherontia* in India where the change from green to brown, when it occurs, may take place either at an early or a late stage, while the adult larva does not habitually retire to the neighbourhood of the ground by daylight. The normal larva of *C. oldenlandiæ*, clad, in the early stages, in velvety black with orange ocelli, is a conspicuous object on the young balsam leaves: the inconspicuous green form is rare. In other species, such as *alecto* and *celerio*, the green form is the normal one. Possibly the situation of larva at the time of moulting, in respect of light and shade, may affect the tendency to change colour as, in captivity, a larger proportion of the two last named species affect the brown colouring in the later stages than appears to be the case out of doors.

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[1] The specimen in question was identified at the British Musem in July 1920, as *Clanis phalaris*. EDS.

A SHORT ACCOUNT OF THE OYSTER INDUSTRY IN THE ISLAND OF BOMBAY AND SALSETTE

BY

H. S. Rai, M.SC. (*The Royal Institute of Science, Bombay*)

(*With five plates and three text figures*)

From time immemorial oysters have been considered a delicacy and as such they are highly prized. During the great war, it was proved by many experiments that oyster flesh has a high food value, as it contains a high percentage of glycogen and nitrogenous compounds. Few articles of food are more nourishing than the edible oyster, but its chief merit lies in its being easily digested. Another good point is that the oyster possesses a great stimulative property, and acts as a tonic to the consumer. The following quotation from the *Lancet*, October 19, 1912 is of some interest in this connection.

'The oyster is a tonic of the first order, and a complete food, most beneficial to weakened patients and those in whom appetite is deficient.'

There are great oyster farms in France, Great Britain, the United States of America, and other maritime countries, in which oysters are cultivated on up-to-date scientific lines.

COMMON BOMBAY OYSTERS

Before proceeding further, it is desirable to give a few notes on the habitat and distribution of edible oysters round about Bombay. (*Vide* Plate V.) About five or six species are found along our coast, of these the following three are important from the economic point of view.

1. *Ostrea gryphoides* (*Sch.*).—Newton and Smith. This is a large oyster, growing to about six to seven inches. The rate of growth is very rapid. The oyster attains marketable size in three or four years. It is generally found in muddy creeks, where it is restricted to the vicinity of the low-tide area. It is sometimes found in fairly deep waters—upto three to four fathoms. This oyster is collected in large numbers by fishermen from various natural beds situated along the coast and transplanted to the Mahim Creek, where it is cultivated on a large scale. The oyster is also sent out to the mofussil towns after satisfying Bombay demands. *Distribution.*—The location of the natural beds are :—Malad, Boisar and Satpuri Creeks, Balghar, Sanjan Kalve, Dahisar and Navapur.

2. *Ostrea cucullata* (Born).—It is a rock oyster, and is found in clusters on rocks exposed at half tides. It seldom exceeds three inches in length. This oyster seems to be a slightly brackish water form. This species ranks next to *O. gryphoides* (Sch.) in

commercial importance. It has a very delicate flavour, and is therefore highly esteemed. It is fished by local fishermen, for the local markets exclusively.

Distribution.—It is common along the coast of Bombay and Salsette Islands, wherever there are rocks, near the shore. A large collection can be made from the following localities in any season of the year. West coast, Colaba, Worli, Mahim, Danda, Malad and Borivili Creeks, and on the east coast (in the harbour) Colaba, Sewri, Trombay and the Thana Creek.

3. *Ostrea virginiana.*—It is a flat oyster of large size, and almost round in shape. The external surface is laminated, and the lines of growth are conspicuous. The muscle scar is oblong, and has a dull white colour, and stands out clearly from the nacreous interior of the valves. Its shell is generally encrusted with red algæ. It is not cultivated, but it is merely collected by fishermen from its natural beds at Mahim. It is rather a deep water form.

Other species of oysters which are not mentioned above are rare and smaller in size. They may, however, be interesting regarding the study of their bionomics; but they are useless at present for markets.

LIFE HISTORY OF THE OYSTER

To illustrate the life history of the oyster, *O. cucullata* is selected since it has been exhaustively studied by the present writer. The sexes are separate, but there are no external sexual differences. Hermaphrodite individuals, however, are sometimes met with. It is very prolific, for it produces a million or more of eggs, but only a small portion of these reach the adult stage.

The active spawning season does not appear to begin before March and generally ends in May. The ripe spermatozoa and the ova are discharged into the surrounding sea water, where fertilisation and development take place. There is an unequal division of the Oosperm (fertilised egg) and the smaller cells of the Oosperm divide rapidly and form a layer which ultimately covers the large cells completely. When the segmentation is well advanced (four hours) the whole surface of the body is covered over by means of cilia. About twenty hours after fertilisation there is a prominent preoral ring of long cilia, which is known as the *'Velum'*. It is characteristic of the trochosphere larva. The larvae swim very actively in all directions and generally crowd near the surface of the water. The velum which is the chief locomotary organ is well developed in the next stage, which is known as the veliger stage. Young oysters after their free swimming life, which may last a week or so, are known as 'spats'. Each spat fixes itself to any object, suitable or unsuitable, which happens to be near at hand, and only those survive which happen to settle on the hard and clear surface of shells (whether of oysters, mussels or cockles, etc.), or stones and rocks and other spat collecting material which is collectively known as 'cultch'. At the time of attachment it is very small and delicate. There is a great mortality among oysters in the spat stage.

It is interesting to note that during the embryonic stages the two valves are of the same size and shape. They are perfectly symmetrical. In the adult the shell of the oyster is unequal. The animal is attached to the rock, or any other hard substance by the left valve, which is larger than the right, and forms a stony box, in which the soft parts of the body lie. The adductor muscle which runs across from valve to valve enables the oyster to shut the valves of the shell against each other with a great force by the contraction of the muscle. When once shut, it is very difficult to open the valves without any injury to the animal.

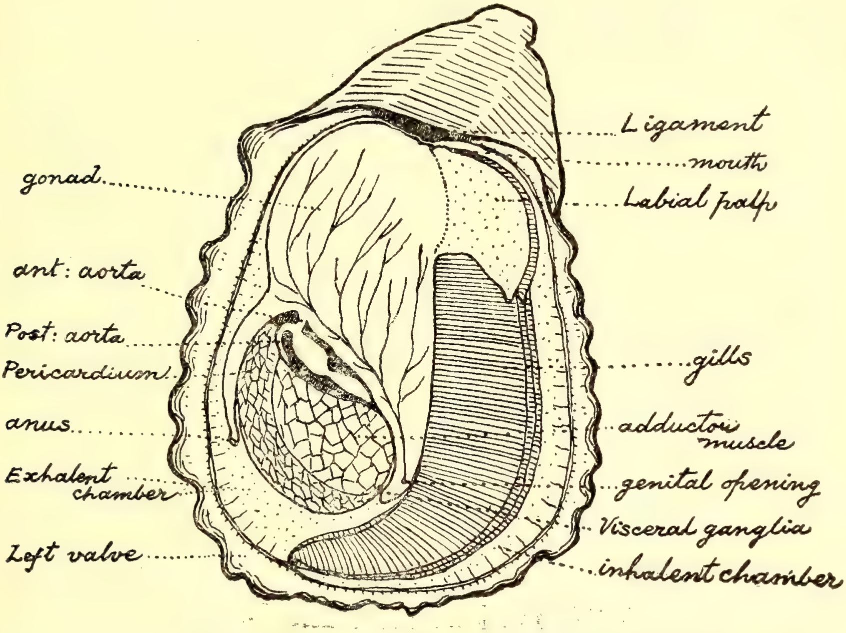


FIG. 1—*Ostrea cucullata.* Right shell and mantle removed.

Soft parts (Anatomy).—Text fig. 1.—As soon as the shells are removed the whole animal is seen to be covered over by a soft structure known as the mantle. The mouth is situated at the extreme anterior end of the body, between the palps. It leads into a long oesaphagus. The latter opens into the spacious stomach. The digestive gland envelopes the stomach on all sides, while its ducts open into the stomach. The intestine forms a single loop on the left side of the body. The rectum runs on the dorsal surface of the adductor muscle and ends into the anus. The head region is very rudimentary. The siphons and the foot are absent.

There are two gills, which consist of four 'demi-branchs', or gill plates. They extend from the anterior to the posterior end of the animal, and are attached partly to the visceral mass (i.e., mass consisting of various organs of the body) and partly to the mantle lobes of both side in such a way that the whole space enclosed by the mantle lobes is divided into two chambers. The chamber in which the gills are hanging is known as the inhalent chamber, and that above the gills in which the anus is situated is called the exhalent chamber.

There is only one muscle present—the posterior adductor muscle—which seems to be powerful enough to close the two valves of the shell, when the animal is disturbed.

The heart is enclosed in the pericardium and is located between the adductor muscle and the visceral mass. The ventricle is large, and muscular. The anterior and posterior aortæ are present. There is a pair of auricles with thin walls.

The nervous system is simple. The cerebral ganglia are insignificant. A large number of nerves are given off from the visceral ganglia, which lie close to the adductor muscle.

The reproductive organs are simple. No accessory organs are found. The gonads when ripe cover the whole visceral mass. The reproductive and the nephridial systems have separate genital and renal openings to the outside. The nephridea are sac-like organs consisting of glandular and non-glandular tissues.

After about four years the oyster becomes adult, and its maximum age is about ten years.

The food of the oyster consists of very minute organisms, animals as well as plants, larvæ, spores, diatoms, etc., which are carried by the currents of water, set in motion by means of cilia on the gills, and the palps. These currents flow continually into the mantle cavity, and are driven to the anterior end of the body and finally into the mouth.

Enemies.—In spite of the hard and thick shell which protects the adult oyster, it has still many enemies in the different stages of its life history. Mortality is very much greater in the larval stages than in the adult condition owing to the various factors which are inimical to its life.

(*a*) The whole bed may be destroyed by an undue amount of fine mud and sand in suspension in the water. It chokes up the gills and kills the animal.

(*b*) The monsoon floods cause great destruction owing to the lowering of the salinity of the sea water on account of inflow of much fresh water into the sea.

(*c*) Growth of the seaweeds, and other invertebrate enemies on the shell.

(*d*) Pea-crab.—supposed to live in harmless association with but seems to have some evil effect on the oyster. This is seen in the change in colour of digestive glands and the size of the body.

(*e*) Boring molluscs (*Murex* sp.), drill holes in the shell and suck up the soft parts.

(*f*) Cliona (sponge) makes holes in the shells so that worms and other small invertebrates can get through the shell and feed on the soft parts of the body.

(*g*) Predatory fishes and crabs eat spat.

(*h*) Star-fishes. They kill the adult oysters with ease.

(*i*) Various stages of the larvæ of the oyster are swallowed by fish wandering in the littoral zone.

BOMBAY OYSTER INDUSTRY

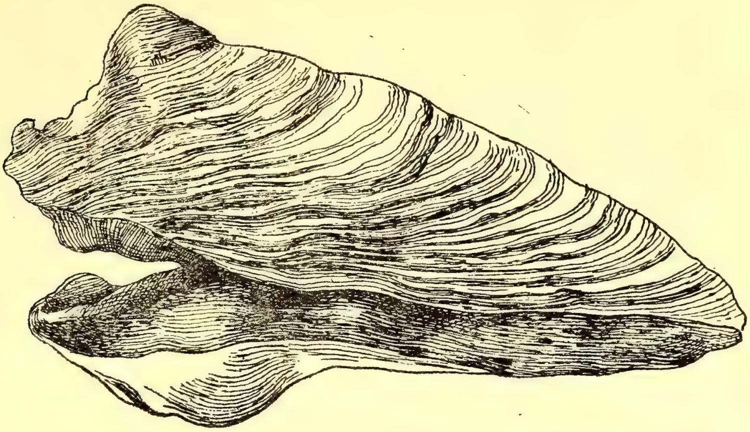


Fig. 1.—SHELL OF *Ostrea gryphoides* (SCH.) ⅓ NAT. SIZE

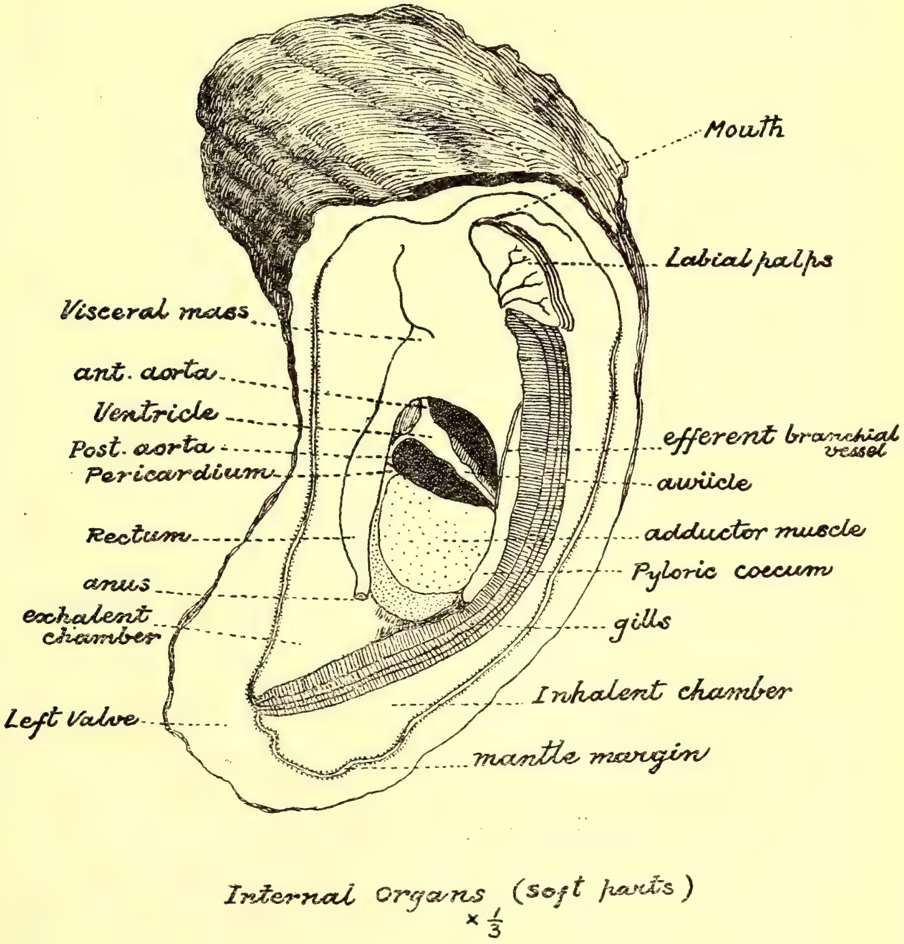

Mouth
Labial palps
Visceral mass
ant. aorta
Ventricle
efferent branchial vessel
Post. aorta
Pericardium
auricle
Rectum
adductor muscle
Pyloric coecum
anus
exhalent chamber
gills
Inhalent chamber
Left Valve
mantle margin
Internal Organs (soft parts)
× 1/3

FIG. 2.—ANATOMY OF *Ostrea gryphoides* (SCH.)

PRESENT METHODS OF OYSTER CULTURE

1. *Oyster farms.*—None of the Western methods in farming oysters are to be seen in this part of the country. It is not definitely known when the oysters began to be farmed in the Mahim Creek. There are many such farms round about the Islands of Bombay and Salsette, but the Mahim farm seems to be the most prosperous. The oysters found there are large, well-shaped, and in excellent condition. The areas of the various farms are small. All of them are well above the line of the low-tide. The ground selected for farming is hard. It is composed of clay and sand covered over with a thin layer of mud.

The method employed at present at Mahim is as follows :—

Young oysters, more or less an inch in diameter, are collected from the open sea and other exposed places. They are then planted in certain selected spots which are easily accessible in all tide conditions. These transplanted oysters are generally cleaned once or twice a month at the low tide and replanted in order to prevent mortality from various enemies. Under these conditions they grow rapidly and within four or five years they measure about four to six inches in diameter.

3. *Cultch.*—No attempt has yet been made by fishermen on this coast to employ any suitable cultch. The spats are found on the natural cultch in the form of shells of oysters dead or living or stray pieces of stones, bricks, or tiles, etc. The putting out of the cultch marks the highest stage yet attained in oyster culture, and different methods for distributing cultch are employed in different countries. At Arachan (France) tiles covered with a thin layer of lime mixed with sand are used as cultch, while in Japan bamboo sticks are employed for the same purpose.

4. *Fishing for Markets.*—The oyster farms are exposed at full low tide. Oysters which are found below the low-tide mark, are collected by diving and breaking off the oysters from the beds by means of an instrument locally called a '*koodal*' (Text. fig. 2.)

5. *Extracting oysters from within the shells.*—After collecting the oysters their shells are opened by breaking them and the soft parts are scooped out by means of an 'oyster knife' (Text fig. 3). They are stored in an earthern pot containing sea water and their soft parts are then sold in the local markets.

Thousands of shelled oysters are despatched to clubs, hotels and private individuals in Bombay or outside. Sometimes to save freight and ensure proper icing, the soft parts of the oysters are packed in tins before despatch.

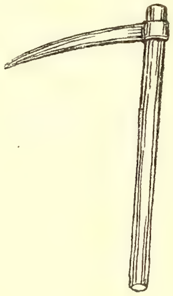


FIG 2.—The *koodal*.

Local demand varies from 1,000 to 2,000 dozens of oysters per month. Many more thousand dozens would be sold if scientific methods were followed. At present there is a suspicion among the public that enteric fevers are caused by oysters.

6. *Fishing seasons.*—The oysters are fished from November to March when they become plump and white and are in a good marketable condition. During the whole season 3,000 to 6,000 dozens oysters are fished. The price varies from annas eight to twelve per dozen. The total earning from all the oyster farms in Bombay approximates Rs. 2,000 to 3,000 *per annum.*

The fishermen stop fishing oysters from the farms, because they are not in demand in the off season between April and October. They are not fit for the market, due to the spawning season (April and May); while in the monsoon season (June to October) the oysters are in a poor condition and their soft parts are watery. As to the number of people employed in the industry it is not easy to give exact figures, since no licenses are issued to men engaged in the oyster industry.

7. *By-products.*—The empty shells of the oyster are used for making lime. They are crushed and put in a kiln, where they are burnt. The burnt fragments are then powdered. This product is much valued, because it makes an excellent lime for building purposes. The empty shells are rather cheap and are sold at the rate of four to six annas a maund.

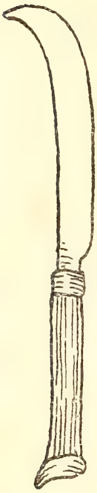


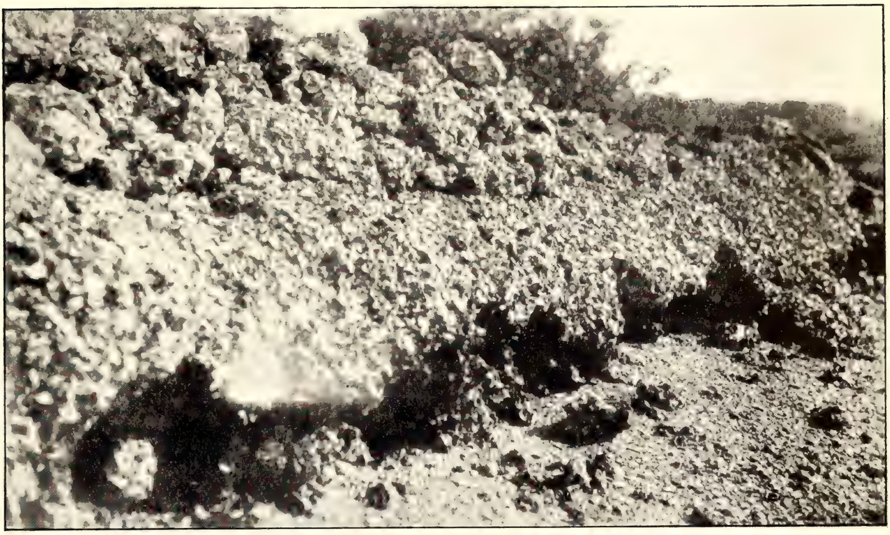
FIG. 3.– An 'Oyster knife.'

Suggestions.—Oyster farming can never be very extensive in Bombay and Salsette Islands, as suitable grounds for oyster farms are not available. The natural oyster beds can however be easily made to yield more revenue than under the present methods. Those engaged in the industry do not know the value of farming oysters on scientific principles. The selection of the ground, the specific gravity of the water, and the time and method of distributing cultch, etc.

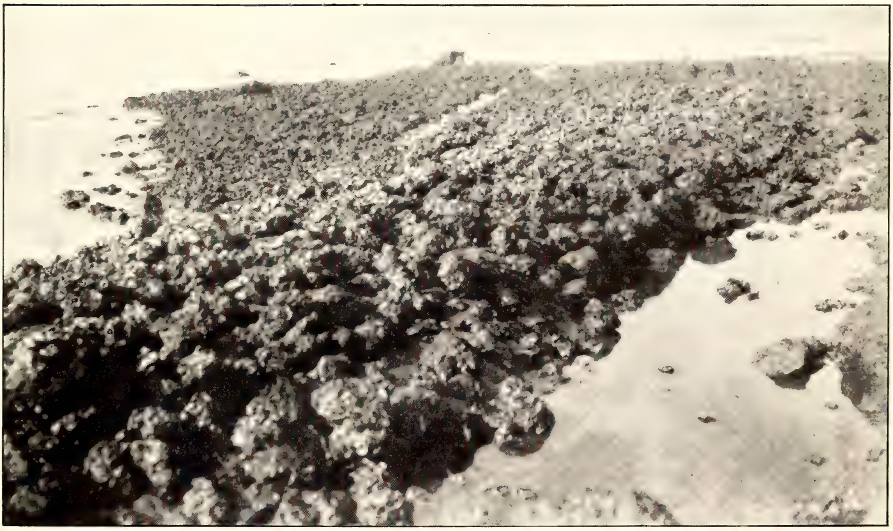
In order to encourage the oyster industry in the Bombay Presidency, certain creeks, and backwaters, which are now known to yield an excellent quantity of oysters should be closed for fishing by the public and regulations and by-laws should be introduced to prevent over-fishing. The Bombay Government should extend to other parts its 'Section 37 of Land Revenue Code (Bombay Act V of 1879) which exercises the rights of proprietorship over the oyster beds in the Sind Creeks'.

The following steps might be taken to put the Bombay oyster industry on a proper footing:—

1. Licensing of fishermen employed in oyster fishing.
2. Observing a close season (mid-March to May) when the oysters spawn.
3. Forbidding the fishing of oysters under three inches.
4. Accurate information regarding the edible oyster, their food value, and the distributing agencies, etc.
5. Survey of oyster beds in different parts of the Presidency.



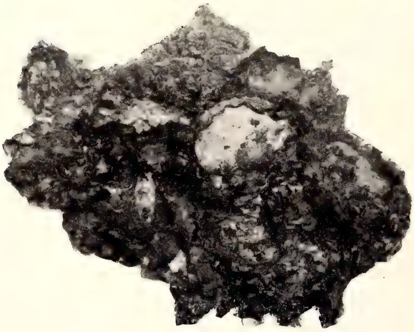
Oyster rock at Mahim at half tide (*O. cucullata*).



Exposed Oyster field at Mahim at low tide (*O. gryphoides* and *O. cucullata*).

Taking out Oysters at Mahim Creek.

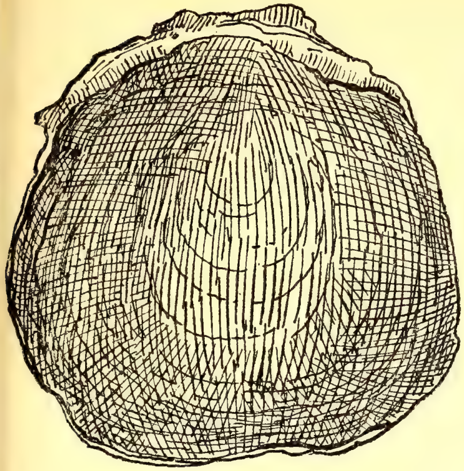
Spat collectors.



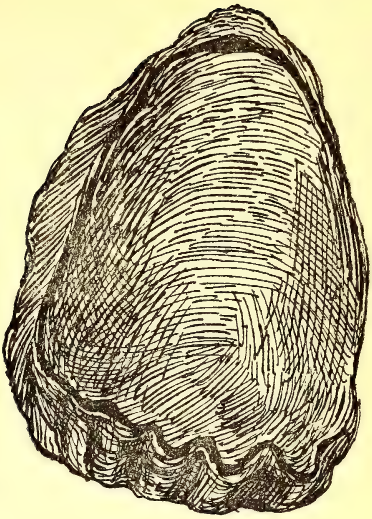
Cluster of *Ostrea cucullata.*

Sucked Oysters.

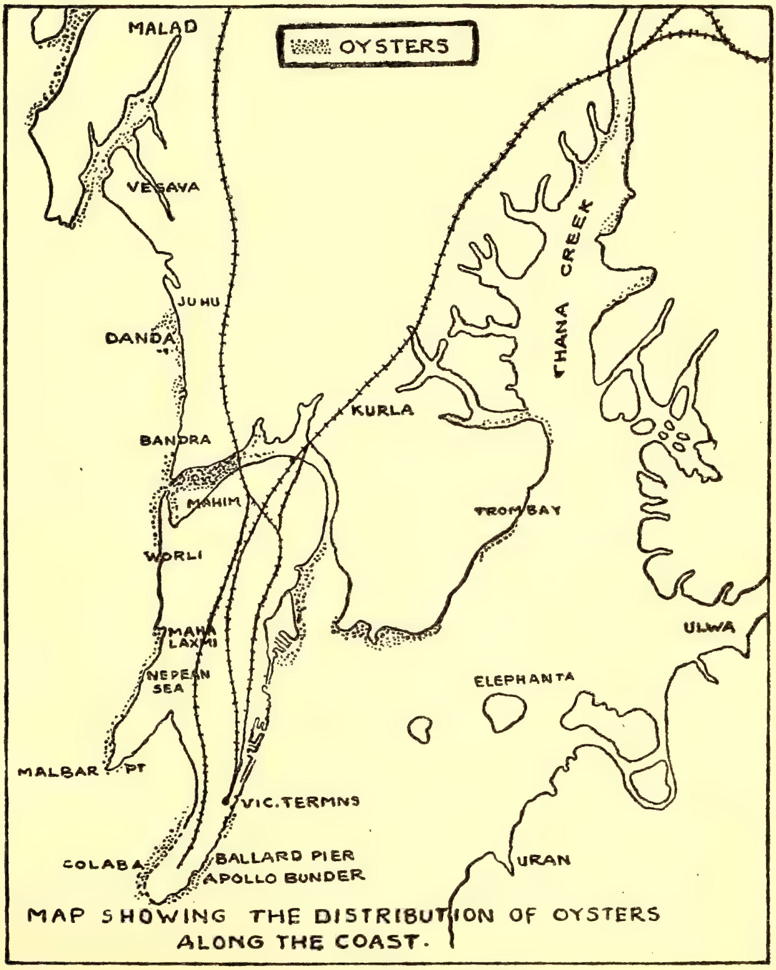
Oysters ready for market.



Ostrea sp × 1/3



Ostrea cucullata × 1/2 (Bom.)


OYSTERS
MALAD
VESAVA
JUHU
DANDA
BANDRA
MAHIM
WORLI
MAHA LAXMI
NEPEAN SEA
MALBAR PT
COLABA
BALLARD PIER
APOLLO BUNDER
VIC. TERMNS
KURLA
THANA CREEK
TROMBAY
ULWA
ELEPHANTA
URAN
MAP SHOWING THE DISTRIBUTION OF OYSTERS ALONG THE COAST.

BOMBAY OYSTER INDUSTRY

THE FLOWERING OF BAMBOOS

BY

E. BLATTER, S.J., Ph.D., F.L.S.

PART I

In 1899 Sir Dietrich Brandis published 'Biological Notes on Indian Bamboos' (*Ind. Forester*, vol. xxv, No. 1, p. 1). He says in the beginning: 'Indian Foresters, who have had the good fortune of witnessing the flowering and seeding of some of the gregariously and periodically flowering Bamboos, will probably agree with me in thinking that a series of remarkable phenomena on a grand scale takes place before our eyes, opening up a multitude of interesting questions, many of which still await solution.' Since then many data and observations have been added to those which were at his disposal thirty years ago and they have been utilized by Troup in his Silviculture of Indian Trees in 1921. He stated a number of problems more lucidly than Brandis was able to do in his time.

In making another attempt to throw some light on the numerous problems, we first give as complete a list as possible of the flowering times of the various species of Bamboos, including also extra-Indian and even American species. Though quite a number of data will be of no use for the present investigation, they may some day prove helpful to future workers.

For practical purposes, the genera as well as the species under the genera have been arranged in alphabetical order.

When starting this list, it was found necessary to revise and to bring up to date the Indian Bamboos. This revision is appearing in the *Indian Forester*.

Name	Year of flowering	Authority	Locality of flowering	Notes
Arundinaria aristata Gamble	1868	Kurz	Singalila Range, above 10,000 ft.	......
	1869	Clarke	Yakla, 11,000 ft.	......
	1890	Gammie	Phalut, 10,000 ft.	......
	1895	Bean	Sikkim	......
	1900	Brandis	Over a small area of Singalila Range	......
,, baviensis Balansa	1886	H. de L.	Tonkin	......
,, callosa Munro	1885	Clarke	Shillong	......
,, densiflora Munro	1890	Trimen	Horton plains, 7,200 ft. (Ceylon)	......
,, elegans Kurz	Annually	Brandis	Assam, Burma	......
,, falcata Nees	1858	Troup	Simla	Gregarious.
	1866–1867	Bean	Europe	......
	1876	Gamble	Kulu	Life-cycle 28–30 years. (Troup). 'Flowers irregularly at times, gregariously over large areas, while a few clumps may be found in flower almost every year.' (Brandis). Flowers 'periodically at long intervals.' (Parker).
	1878	Brandis	Jaunsar	......
	1879	Gamble	N. W. Himalaya	General flowering.
	1881	Brandis	Manglad Valley, 6,000 ft.	......
	1881	,,	Chakrata, 6,000 ft.	......
	1884	Bean	Kew	About the same time in several other places in England (Bean).—'Flowers both sporadically and gregariously. (Troup).
	1886	Broun	Jaunsar	Gregarious.
	1908	Troup	Kew	......
	1916	,,	Simla (cultivated)	Flowered freely.
	1916	,,	Jaunsar	Gregarious.
,, falcata var. glomerata	Almost annually	Bean	Kew (native of India)	......

		1879	H. de L. ...	India ...	Flowers almost every year at Kew on a certain number of culms, but the plant as a whole does not suffer. (Bean).
,,	Falconeri Benth. & Hook.	1821	Wallich ...	Nepal ...	......
		1846	Ex Stapf ...	Pindari Glacier ...	Seeds of this flowering brought to Europe in 1846, offspring flowered in 1875, 1876.
		1875, 1876	Camus ...	Europe and Algeria ...	Nearly all the plants flowered and died in 1876.
		1876	Clarke ...	Sikkim ...	General flowering.
		1877	Bean ...	Holland House (England)	'Flowers gregariously'. (Brandis).
		1893 1894	,, ...	Kew ...	Old culms, not the entire plant flowered.
		1900	Brandis ...	Darjeeling ...	Although the general flowering may occur in one particular year, it is heralded by the flowering of a few forerunners the previous year and followed by that of laggards the next. (Bean).
		1908, 1909	H. de L. ...	Europe ...	......
,,	floribunda Thw. ...	1853	Thwaites ...	Ceylon, 5,000 ft. ...	......
,,	gracilis Blanchard	1830, 1860, 1890	H. de. L. ...	Europe (native of the Himalaya?) ...	......
,,	griffithiana Munro	1835	Griffith	Assam ...	......
		1910	H. de L. ...	Europe ...	......
,,	Hindsii Munro ...	1877, 1880, 1886	,, ...	E. Asia ...	......
		1910	,, ...	Europe ...	......
,,	Hookeriana Munro	1848	Hook. f. ...	Sikkim and Brit. Bhutan	......
		1885	Pantling ...	Choongtang, 5,600 ft....	......
		1892	Gammie ...	Gheet Valley, 6,000 ft. (Bhutan)	......
		1898	H. de L. ...	Kew ...	......
		1899	Bean ...	Kew and Glasnevin ...	All the Kew plants died. At Glasnevin some died, others recovered. (Bean).

Name	Year of flowering	Authority	Locality of flowering	Notes
Arundinaria aristata Gamble ..	1868	Kurz ..	Singalila Range, above 10,000 ft.	
	1869	Clarke ...	Yakla, 11,000 ft. ...	
	1890	Gammie ...	Phalut, 10,000 ft. ..	
	1895	Bean ...	Sikkim ..	
	1900	Brandis ..	Over a small area of Singalila Range	
,, baviensis Balansa	1886	H. de L. ...	Tonkin ..	
,, callosa Munro ...	1885	Clarke ...	Shillong ...	
,, densiflora Munro	1890	Trimen ...	Horton plains, 7,200 ft. (Ceylon)	
,, elegans Kurz .	Annually	Brandis ...	Assam, Burma ...	.. ..
,, falcata Nees .	1858	Troup ...	Simla ...	Gregarious.
	1866–1867	Bean ...	Europe ..	......
	1876	Gamble ...	Kulu ...	Life-cycle 28–30 years. (Troup). 'Flowers irregularly at times, gregariously over large areas, while a few clumps may be found in flower almost every year.' (Brandis). Flowers 'periodically at long intervals.' (Parker)
	1878	Brandis ...	Jaunsar ...	... ..
	1879	Gamble ...	N. W. Himalaya .	General flowering
	1881	Brandis ...	Manglad Valley, 6,000 ft	.....
	1881	,, ...	Chakrata, 6,000 ft. ..	......
	1884	Bean ...	Kew ...	About the same time in several other places in England (Bean).—' Flowers both sporadically and gregariously. (Troup).
	1886	Broun ..	Jaunsar ...	Gregarious.
	1908	Troup ...	Kew ...	......
	1916	,, ...	Simla (cultivated) ...	Flowered freely
	1916	,, ...	Jaunsar ...	Gregarious.
,, falcata var. glomerata	Almost annually	Bean ...	Kew (native of India)...	......
	1879	H. de L. ...	India ...	Flowers almost every year at Kew on a certain number of culms, but the plant as a whole does not suffer. (Bean).
,, Falconeri Benth. & Hook.	1821	Wallich ...	Nepal ...	......
	1846	Ex Stapf ...	Pindari Glacier ...	Seeds of this flowering brought to Europe in 1846, offspring flowered in 1875, 1876.
	1875, 1876	Camus ...	Europe and Algeria ...	Nearly all the plants flowered and died in 1876.
	1876	Clarke ...	Sikkim ..	General flowering.
	1877	Bean ...	Holland House (England)	'Flowers gregariously'. (Brandis).
	1893 1894	,, ...	Kew ...	Old culms, not the entire plant flowered
	1900	Brandis ...	Darjeeling ...	Although the general flowering may occur in one particular year, it is heralded by the flowering of a few forerunners the previous year and followed by that of laggards the next. (Bean).
	1908, 1909	H. de L. ...	Europe ...	... ..
,, floribunda Thw. ...	1853	Thwaites ...	Ceylon, 5,000 ft. ...	... ..
,, gracilis Blanchard	1830, 1860, 1890	H. de. L. ...	Europe (native of the Himalaya?)	......
,, griffithiana Munro	1835	Griffith	Assam ...	......
	1910	H. de L. ...	Europe ...	......
,, Hindsii Munro ...	1877, 1880, 1886	,, ...	E. Asia ...	......
	1910	,, ...	Europe ...	......
,, Hookeriana Munro	1848	Hook. f. ...	Sikkim and Brit. Bhutan	......
	1885	Pantling ...	Choongtang, 5,600 ft....	......
	1892	Gammie ...	Gheet Valley, 6,000 ft. (Bhutan)	......
	1898	H. de L. ...	Kew ...	......
	1899	Bean ...	Kew and Glasnevin ...	All the Kew plants died. At Glasnevin some died, others recovered. (Bean).

Name	Year of flowering	Authority	Locality of flowering	Notes
Arundinaria Hookeriana Munro	1903	Brandis	Sikkim and Brit. Bhutan	......
,, humillima Pilger	1902	H. de L.		
,, intermedia Munro	1848	Hook f.	Sikkim	......
	1868	Anderson	,,	......
	1879	Gamble	,,	Isolated flowering clumps occasionally met with.
	1889	H.K.	...	
	1899	Bean	Kew	Died after flowering. (Bean).
	1907	Camus	Europe	......
	1910	H. de L.	,,	......
,, khasiana Munro	1850	Hooker	Khasia Hills	......
	1889	Masters	,,	......
	1905	Camus	France (cultivated)	......
,, macrosperma Michx.	1803	H. de L.	N. America	......
	Between 1872 and 1878	Bean	,,	......
,, Maling Gamble	1904	Osmaston	Mt. Tonglo, 9,000 ft. (Sikkim)	......
,, Maximowiczii Hort.	1896	Bean	Kew, Bamboo Garden	Flowered all over the plant and died 1897.
	1897, 1898, 1899, 1900	Mitford	Batsford	Very likely partial flowering plants did not die. (Mitford).
,, nitida Mitford	1900	Wilson	W. Hupeh, China	......
,, Pantlingi Gamble	1895	Pantling	Brit. Bhutan, 11,000 ft.	......
,, polystachya Kurz	1868, 1876	Gamble	Sikkim, Khasia Hills	......
,, Prainii Gamble	1886	Prain	Naga Hills, 7,870 ft.	......
	1889	Mann	Jaintia Hills, 3,500 ft.	......
	1891	Rollo	Naga Hills, 5,400 ft.	......
,, racemosa Munro emend.	1857	Thomson	Sikkim	......

	1887	King's coll.	Singalila (Sikkim)	......
	1890	,, ,,	Phalut, 10,000 ft. (Sikkim)	......
	1892	Gammie	Phalut, 11,500 ft. (Sikkim)	......
,, Sat Balansa	1887	H. de L.	Tonkin	......
,, Simoni A. & C.Riv.	1876	Rivière	...	......
	1892	Bean	Kew (native of China)	Odd culms flowered and died, plants not affected. (Bean).
	1893–1902	,,	Kew	......
	1903	,,	Kew, Temperate House.	Every culm flowered, seeded and died. (Bean).
	1904–1905	,,	Kew, Bamboo Garden	Every culm flowered, and died. (Bean)
	1903, 1910	H. de L.	Europe	
,, Simoni var. variegata H.f.	1877	Bot. Mag.	Kew	Not known whether partial or general.
	1902, 1903, 1904, 1905.	Camus	Europe	......
,, spathiflora Trin.	1821	Wallich	N.-W. Himalaya	Fowers sporadically and gregariously. (Troup).
	1881	Brandis	Jaunsar	Flowers probably every 10 years. (Brandis).
	1882	Brandis, Fischer	,,	General flowering.
	1892	Gamble	Deoban	......
	1893	,,	Tehri-Garhwal	......
,, Trianæ Munro	1856	H. de L.	New Granada	......
,, variabilis Mak.	1897	,,	Japan	......
,, variabilis var. Fortunei.	1906, 1910	,,	Europe (native of Japan)	......
,, Walkeriana Munro	1861, 1888	Gamble	Ceylon	'Probably flowers frequently.' (Gamble).
,, Wightiana Nees	Annually	,,	Nilgiris, S. India, Ceylon	Does not die after flowering.
Bambusa arundinacea Willd.	1804	Beddome	W. Coast of India	Gregarious.
	1812	Gamble	Orissa	......
	1836	Sleeman	Dehra Dun	Gregarious.
	1839	Brandis	Near Jubbulpore	......

Name	Year of flowering	Authority	Locality of flowering	Notes
Arundinaria Hookeriana Munro	1903	Brandis	Sikkim and Brit. Bhutan	......
,, humillima Pilger	1902	H. de L.		
,, intermedia Munro	1848	Hook f.	Sikkim	......
	1868	Anderson	,,	......
	1879	Gamble	,,	Isolated flowering clumps occasionally met with.
	1889	H.K.	...	
	1899	Bean	Kew	Died after flowering. (Bean).
	1907	Camus	Europe	......
	1910	H. de L.	,,	.....
,, khasiana Munro	1850	Hooker	Khasia Hills	......
	1889	Masters	,,	......
	1905	Camus	France (cultivated)	......
,, macrosperma Michx.	1803	H. de L.	N. America	......
	Between 1872 and 1878	Bean	,,	......
,, Maling Gamble	1904	Osmaston	Mt. Tonglo, 9,000 ft. (Sikkim)	......
,, Maximowiczii Hort.	1896	Bean	Kew, Bamboo Garden	Flowered all over the plant and died 1897.
	1897, 1898, 1899, 1900	Mitford	Batsford	Very likely partial flowering plants did not die. (Mitford).
,, nitida Mitford	1900	Wilson	W. Hupeh, China	......
,, Pantlingi Gamble	1895	Pantling	Brit. Bhutan, 11,000 ft.	......
,, polystachya Kurz	1868, 1876	Gamble	Sikkim, Khasia Hills	......
,, Prainii Gamble	1886	Prain	Naga Hills, 7,870 ft.	......
	1889	Mann	Jaintia Hills, 3,500 ft.	......
	1891	Rollo	Naga Hills, 5,400 ft.	......
,, racemosa Munro emend.	1857	Thomson	Sikkim	......
	1887	King's coll.	Singalila (Sikkim)	..
	1890	,, ,,	Phalut, 10,000 ft. (Sikkim)	.. ..
	1892	Gammie	Phalut, 11,500 ft. (Sikkim)	.. ...
,, Sat Balansa	1887	H. de L.	Tonkin	......
,, Simoni A. & C.Riv.	1876	Rivière	...	......
	1892	Bean	Kew (native of China)	Odd culms flowered and died, plants not affected. (Bean).
	1893–1902	,,	Kew	......
	1903	,,	Kew, Temperate House.	Every culm flowered, seeded and died. (Bean).
	1904–1905	,,	Kew, Bamboo Garden	Every culm flowered, and died. (Bean)
	1903, 1910	H. de L.	Europe	
,, Simoni var. variegata H.f.	1877	Bot. Mag.	Kew	Not known whether partial or general.
	1902, 1903, 1904, 1905.	Camus	Europe	......
,, spathiflora Trin.	1821	Wallich	N.-W. Himalaya	Fowers sporadically and gregariously. (Troup).
	1881	Brandis	Jaunsar	Flowers probably every 10 years. (Brandis).
	1882	Brandis, Fischer	,,	General flowering.
	1892	Gamble	Deoban	......
	1893	,,	Tehri-Garhwal	......
,, Trianæ Munro	1856	H. de L.	New Granada	......
,, variabilis Mak.	1897	,,	Japan	......
,, variabilis var. Fortunei.	1906, 1910	,,	Europe (native of Japan)	......
,, Walkeriana Munro	1861, 1888	Gamble	Ceylon	'Probably flowers frequently.' (Gamble).
,, Wightiana Nees	Annually	,,	Nilgiris, S. India, Ceylon	Does not die after flowering.
Bambusa arundinacea Willd.	1804	Beddome	W. Coast of India	Gregarious.
	1812	Gamble	Orissa	......
	1836	Sleeman	Dehra Dun	Gregarious.
	1839	Brandis	Near Jubbulpore	......

Name	Year of flowering	Authority	Locality of flowering	Notes
Bambusa arundinacea Willd....	1864	Gamble	N. Kanara	.....
	1865	,,	Balaghat District (C. Prov.)	......
	1866	Brandis	Malabar, S. Kanara, Wynaad, Coorg	Gregarious.
	1868	Beddome	W. Coast of India	......
	1869	Brandis	Satpuras	Gregarious.
	1870	,,	Jubbulpore (planted)	Three-fifths of the Bamboos of the station flowered, seeded and died. (Nicholls).
	1870	Bourdillon	S. Travancore	......
	1874	Gamble	Malda	......
	About 1874 to 1884, mainly 1878	Troup	Kanara, Belgaum, Dharwar	Gregarious.
	1879–1880	Bourdillon	N. Travancore	......
	1880	Wood	Oudh	......
	1881	Brandis	Dehra Dun, planted	Gregarious.
	1881	Gamble	Dehra Dun	Gregarious, planted trees only.
	1881	Brandis	Basudeo (Kumaon)	Gregarious.
	1881	,,	Head-waters of Noyil (Coimbatore)	,,
	1882	Nicholls	Narsinghpur	2 clumps in flower.
	1882	Bourdillon	W. Coast of India	Gregarious.
	1885	Nicholls	Narsinghpur	......
	1889	Gamble	Kurnool	......
	1890	Brandis	...	......
	1893	Gamble	...	......
	1894	McIntosh	Cuddapah	......
	1896	Troup	Walayar forest, Coimbatore	Gregarious.
	1896	Brandis	Rajpipla State	,,
	1900	Troup	Dehra Dun, planted	,,

	About 1905 to 1918, chiefly 1912	Troup	Kanara, Belgaum, Dharwar	,,
	1910	,,	Throughout the Dangs.	,,
	1912-1915	,,	Wynaad, Kollegāl, Coimbatore	Gregarious, began on plateau tracts of Wynaad and spread southwards to Kollegal and Coimbatore.
	1913	,,	Bihar and Orissa	Gregarious.
	1913–1915	,,	Coorg	Gregarious. 'Isolated flowering clumps are found occasionally, but as a rule all clumps in one flowering district come into flower simultaneously, a few clumps flowering in the previous and some in the succeeding year.' (Brandis). Brandis calculates that general flowering takes place in periods of 30–32 years, Gamble in periods of about 30 years. Troup of 32–34 years.
Bambusa balcooa Roxb.	1849	Hook. f.	Purnea Distr.	'Flowers at long intervals.' (Brandis).
	1876	Mann	Goalpura	......
	1881	Wood	Corackpore	......
	1889	Pani Ram Das	Kamrup	......
,, burmanica Gamble	1890	Oliver	Katha Distr. (Upper Burma)	......
,, griffithiana Munro	1837	Griffith	Mogaung river (Upper Burma)	......
,, khasiana Munro	1850	Hook. & Thoms.	Jasper Hill, Mahadeb...	......
	1885	Clarke	Jaintiapur	......
,, lineata Munro	Annually	Brandis	In several Bot. Gardens	'Constantly found in flower in the Bot. Gardens at Calcutta and Peradeniya.' (Gamble).
,, nana Roxb.	1893	H. de L.	Japan ; Kew	Flowers rarely below 700 m. in the Malay Peninsula. (Camus).
,, nana var. Alphonse Karri M.	1908, 1910	,,	France	......

Name	Year of flowering	Authority	Locality of flowering	Notes
Bambusa arundinacea Willd.	1864	Gamble	N. Kanara	......
	1865	,,	Balaghat District (C. Prov.)	......
	1866	Brandis	Malabar, S. Kanara, Wynaad, Coorg	Gregarious.
	1868	Beddome	W. Coast of India	......
	1869	Brandis	Satpuras	Gregarious.
	1870	,,	Jubbulpore (planted)	Three-fifths of the Bamboos of the station flowered, seeded and died. (Nicholls).
	1870	Bourdillon	S. Travancore	......
	1874	Gamble	Malda	......
	About 1874 to 1884, mainly 1878	Troup	Kanara, Belgaum, Dharwar	Gregarious.
	1879–1880	Bourdillon	N. Travancore	......
	1880	Wood	Oudh	......
	1881	Brandis	Dehra Dun, planted	Gregarious.
	1881	Gamble	Dehra Dun	Gregarious, planted trees only.
	1881	Brandis	Basudeo (Kumaon)	Gregarious.
	1881	,,	Head-waters of Noyil (Coimbatore)	,,
	1882	Nicholls	Narsinghpur	2 clumps in flower.
	1882	Bourdillon	W. Coast of India	Gregarious.
	1885	Nicholls	Narsinghpur	......
	1889	Gamble	Kurnool	......
	1890	Brandis	...	......
	1893	Gamble	...	......
	1894	McIntosh	Cuddapah	......
	1896	Troup	Walayar forest, Coimbatore	Gregarious.
	1896	Brandis	Rajpipla State	,,
	1900	Troup	Dehra Dun, planted	,,
	About 1905 to 1918, chiefly 1912	Troup	Kanara, Belgaum, Dharwar	,,
	1910	,,	Throughout the Dangs.	,,
	1912-1915	,,	Wynaad, Kollegal, Coimbatore	Gregarious, began on plateau tracts of Wynaad and spread southwards to Kollegal and Coimbatore.
	1913	,,	Bihar and Orissa	Gregarious.
	1913–1915	,,	Coorg	Gregarious. 'Isolated flowering clumps are found occasionally, but as a rule all clumps in one flowering district come into flower simultaneously, a few clumps flowering in the previous and some in the succeeding year.' (Brandis). Brandis calculates that general flowering takes place in periods of 30–32 years, Gamble in periods of about 30 years. Troup of 32–34 years.
Bambusa balcooa Roxb.	1849	Hook. f.	Purnea Distr.	'Flowers at long intervals.' (Brandis).
	1876	Mann	Goalpura	......
	1881	Wood	Gorackpore	......
	1889	Pani Ram Das	Kamrup	......
,, burmanica Gamble	1890	Oliver	Katha Distr. (Upper Burma)	......
,, griffithiana Munro	1837	Griffith	Mogaung river (Upper Burma)	......
,, khasiana Munro	1850	Hook. & Thoms.	Jasper Hill, Mahadeb...	......
	1885	Clarke	Jaintiapur	......
,, lineata Munro	Annually	Brandis	In several Bot. Gardens	'Constantly found in flower in the Bot. Gardens at Calcutta and Peradeniya.' (Gamble).
,, nana Roxb.	1893	H. de L.	Japan; Kew	Flowers rarely below 700 m. in the Malay Peninsula. (Camus).
,, nana var. Alphonse Karri M.	1908, 1910	,,	France	......

Name	Year of flowering	Authority	Locality of flowering	Notes
Bambusa nana var. gracillima...	1911	H. de L. ...	Europe ...	......
,, nutans Wall. ...	1840	Falconer ...	Dehra Dun ...	'Seems to flower only at long intervals.' (Gamble).
	1886	H. de L. ...	...	......
	1893	Gamble ...	Dehra Dun ...	Flowers 'periodically at long intervals.' (Parker).
	1894	,, ...	,, ...	......
,, oliveriana Gamble ...	1893–1894	Oliver ...	Upper Burma ...	Apparently the flowering was general. (Oliver).
,, pallida Munro ...	1850	Hook. & Thoms.	Eastern Bengal ...	......
	1890	Pani Ram Das ...	Kamrup, Assam ...	......
,, polymorpha Munro ...	1852	Troup ...	Upper Zamayi forest ...	'Flowers gregariously and periodically, dies after seeding.' (Brandis).
	1854	M'Clelland ...	Pegu ...	......
	1856, 1857, 1858	Brandis ...	Pegu Yoma ...	'Flowers at long intervals, and the flowering is remarkably gregarious.' (Troup).
	1859	,, ...	W. side of the Pegu Yoma	General flowering.
	1860	,, ...	W. side of the Pegu Yoma in the northern portion	,, ,,
	1862	,, ...	Zamayi forests, Burma	......
	1871	Kurz ...	Thankyegat forests ...	......
	1899	Troup ...	Pegu ...	3 clumps reported to have flowered. (Troup).
	1903	,, ...	Tharrawady forests ...	2 flowering clumps.
	1913	,, ...	Mimbu, Thayetmyo, Prome	Sporadic.
	1914	,, ...	Prome ...	Flowered over an area of about 3 square miles; this is the first record of anything approaching gregarious flowering for about 55 years. (Troup).

		1918	,,	W. side of Pegu Yoma	There have been signs of an approaching general flowering ; if this materializes, the life-cycle of the bamboo may be placed at about 60 years or a little more. (Troup).
,,	Ridleyi Gamble	1890	Ridley	Singapore	......
,,	teres Hamilton	1809	Hamilton	Gongachora	......
,,	Tulda Roxb.	1859	H. de L.	......	......
		About 1865	Troup	Tharrawaddy	Gregarious.
		1867, 1868	Kurz	Lower Bengal	,,
		1872	Clarke	,, ,,	,,
		1876	Lister	Chittagong	,,
		1880	Brandis	Burma	,,
		1884	Clarke	Lower Bengal	,,
		1886	Ellis	Chittagong	,,
		1889	Mann	Assam	,,
		1892	Oliver	Burma	......
		1903–1905	Troup	Tharrawaddy	Gregarious. ' Fairly extensive flowering in single clumps or groups of varying extent.' (Troup).
,,	Tulda Roxb.	1908	Troup	Prome	Gregarious.
		1910	,,	Sylhet	,,
		1911	,,	Gangaw	,,
		1913	,,	Toungoo, Zigon, Rangoon	,,
		1914	,,	S. Toungoo, Pegu, Prome Zigon, Tharrawaddy, Rangoon, Henzada, Yaw	,,
		1915	,,	N. Toungoo, Shwegyu, Prome, Zigon	,,

Name	Year of flowering	Authority	Locality of flowering	Notes
Bambusa nana var. gracillima	1911	H. de L.	Europe	......
,, nutans Wall.	1840	Falconer	Dehra Dun	'Seems to flower only at long intervals.' (Gamble).
	1886	H. de L.	...	......
	1893	Gamble	Dehra Dun	Flowers 'periodically at long intervals.' (Parker).
	1894	,,	,,	......
,, oliveriana Gamble	1893–1894	Oliver	Upper Burma	Apparently the flowering was general. (Oliver).
,, pallida Munro	1850	Hook. & Thoms.	Eastern Bengal	......
	1890	Pani Ram Das	Kamrup, Assam	......
,, polymorpha Munro	1852	Troup	Upper Zamayi forest	'Flowers gregariously and periodically, dies after seeding.' (Brandis).
	1854	M'Clelland	Pegu	......
	1856, 1857, 1858	Brandis	Pegu Yoma	'Flowers at long intervals, and the flowering is remarkably gregarious.' (Troup).
	1859	,,	W. side of the Pegu Yoma	General flowering.
	1860	,,	W. side of the Pegu Yoma in the northern portion	,, ,,
	1862	,,	Zamayi forests, Burma	......
	1871	Kurz	Thankyegat forests	......
	1899	Troup	Pegu	3 clumps reported to have flowered. (Troup).
	1903	,,	Tharrawady forests	2 flowering clumps.
	1913	,,	Mimbu, Thayetmyo, Prome	Sporadic.
	1914	,,	Prome	Flowered over an area of about 3 square miles; this is the first record of anything approaching gregarious flowering for about 55 years. (Troup).
	1918	,,	W. side of Pegu Yoma	There have been signs of an approaching general flowering; if this materializes, the life-cycle of the bamboo may be placed at about 60 years or a little more. (Troup).
,, Ridleyi Gamble	1890	Ridley	Singapore	.....
,, teres Hamilton	1809	Hamilton	Gongachora	.....
,, Tulda Roxb.	1859	H. de L.	......	......
	About 1865	Troup	Tharrawaddy	Gregarious.
	1867, 1868	Kurz	Lower Bengal	,,
	1872	Clarke	,, ,,	,,
	1876	Lister	Chittagong	,,
	1880	Brandis	Burma	,,
	1884	Clarke	Lower Bengal	,,
	1886	Ellis	Chittagong	,,
	1889	Mann	Assam	,,
	1892	Oliver	Burma	......
	1903–1905	Troup	Tharrawaddy	Gregarious. 'Fairly extensive flowering in single clumps or groups of varying extent.' (Troup).
,, Tulda Roxb.	1908	Troup	Prome	Gregarious.
	1910	,,	Sylhet	,,
	1911	,,	Gangaw	,,
	1913	,,	Toungoo, Zigon, Rangoon	,,
	1914	,,	S. Toungoo, Pegu, Prome Zigon, Tharrawaddy, Rangoon, Henzada, Yaw	,,
	1915	,,	N. Toungoo, Shwegyu, Prome, Zigon	,,

Name	Year of flowering	Authority	Locality of flowering	Notes
Bambusa Tulda Roxb.	1916	Troup	S. Shan States	Gregarious. 'At times flowers gregariously, while at other times single clumps are in flower.' (Brandis). Single clumps, if badly treated by over-cutting or partly uprooted, will often produce flowers without any general flowering. (Gamble).
,, vulgaris Schrad.	1851	Hook. f.	Chittagong	......
	1863	Thwaites	Ceylon	......
	1879	Chester	Chittagong	......
	1890	King	Bot. Gard. Calcutta	......
	1892	Ridley	Singapore Garden	......
Cephalostachyum capitatum Munro	1830	Griffith	Khasia Hills	Seems to flower at very frequent intervals. 'Perhaps the real reason is that like *Dendrocalamus strictus*, it flowers sporadically and then now and again, has years of wholesale seeding, as happened in my own observation in 1874, when large tracts in the Chel and Neora valleys in Brit. Bhutan covered with this species died off.' (Gamble).
	1835	Griffith	Khasia Hills	......
	1848 ?	Hook. & Thoms.	Sikkim	......
	1850	,, ,,	Khasia Hills	......
	1866	T. Anderson	Sikkim	......
	1869	C. B. Clarke	,,	......
	1871, 1872	,, ,,	Khasia Hills	......
	1874	Gammie	Sikkim	......
	1874	,,	Brit. Bhutan	......
	1878	G. King	Sikkim	......
	1892	Gammie	,,	......
,, fuchsianum Gamble	1875	Lister	Daphla Hills	......

		1877 ?	Fuchs	,,	......
		1880	Gamble	,,	......
		1889	Gammie		......
		1892	,,		......
,,	latifolium Munro	1835	Griffith	Brit. Bhutan	
		1879	Gamble	,,	......
		1882	G. Watt	Manipur	......
,,	pallidum Munro	1835	Griffith	Assam	......
		1872	C. B. Clarke	,,	......
		1878	G. Mann	,,	......
		1885–1886	C. B. Clarke	,,	......
,,	pergracile Munro	1859	Brandis	Burma	......
		1862	,,	,,	......
		1865	Troup	Tharrawaddy	Gregarious.
		1875–1876	,,	Prome and Tharrawaddy	Extensive gregarious flowering.
		1880	Brandis	Burma	......
		1887–1888	Troup	Tharrawaddy	Gregarious.
		1894–1895	,,	,,	,,
		1899–1900	,,	Pyinmana (Burma)	,,
		1900–1907	,,	Upper Chindwin, Myittha and Katha	Gregarious. Commenced in Upper Chindwin and spread in a wave southward and eastwards. Auktaw and Pile reserves, Katha in 1905–1906.(Troup).
		1902–1903	,,	Shwegyin	Gregarious.
		1906–1908	,,	Pyinmana	,,
		1906–1909	,,	Toungoo (Gwethe and Kabaung reserves in 1906–7)	,,
		1907–1910	,,	Henzada	,,
		1908–1909	,,	Bassein	,,
		1911–1912	,,	Pegu, Shwegyin	,,

Name	Year of flowering	Authority	Locality of flowering	Notes
Bambusa Tulda Roxb.	1916	Troup	S. Shan States	Gregarious. 'At times flowers gregariously, while at other times single clumps are in flower.' (Brandis). Single clumps, if badly treated by over-cutting or partly uprooted, will often produce flowers without any general flowering. (Gamble).
,, vulgaris Schrad.	1851	Hook. f.	Chittagong	......
	1863	Thwaites	Ceylon	......
	1879	Chester	Chittagong	......
	1890	King	Bot. Gard. Calcutta	......
	1892	Ridley	Singapore Garden	......
Cephalostachyum capitatum Munro	1830	Griffith	Khasia Hills	Seems to flower at very frequent intervals. 'Perhaps the real reason is that like *Dendrocalamus strictus*, it flowers sporadically and then now and again, has years of wholesale seeding, as happened in my own observation in 1874, when large tracts in the Chel and Neora valleys in Brit. Bhutan covered with this species died off.' (Gamble).
	1835	Griffith	Khasia Hills	......
	1848 ?	Hook. & Thoms.	Sikkim	......
	1850	,, ,,	Khasia Hills	......
	1866	T. Anderson	Sikkim	......
	1869	C. B. Clarke	,,	......
	1871, 1872	,, ,,	Khasia Hills	......
	1874	Gammie	Sikkim	......
	1874	,,	Brit. Bhutan	......
	1878	G. King	Sikkim	......
	1892	Gammie	,,	......
,, fuchsianum Gamble	1875	Lister	Daphla Hills	......
	1877 ?	Fuchs	,,	......
	1880	Gamble	,,	......
	1889	Gammie		......
	1892	,,		......
,, latifolium Munro	1835	Griffith	Brit. Bhutan	......
	1879	Gamble	,,	......
	1882	G. Watt	Manipur	......
,, pallidum Munro	1835	Griffith	Assam	......
	1872	C. B. Clarke	,,	......
	1878	G. Mann	,,	......
	1885–1886	C. B. Clarke	,,	......
,, pergracile Munro	1859	Brandis	Burma	......
	1862	,,	,,	......
	1865	Troup	Tharrawaddy	Gregarious.
	1875–1876	,,	Prome and Tharrawaddy	Extensive gregarious flowering.
	1880	Brandis	Burma	......
	1887–1888	Troup	Tharrawaddy	Gregarious.
	1894–1895	,,	,,	,,
	1899–1900	,,	Pyinmana (Burma)	,,
	1900–1907	,,	Upper Chindwin, Myittha and Katha	Gregarious. Commenced in Upper Chindwin and spread in a wave southward and eastwards. Auktaw and Pile reserves, Katha in 1905–1906. (Troup).
	1902–1903	,,	Shwegyin	Gregarious.
	1906–1908	,,	Pyinmana	,,
	1906–1909	,,	Toungoo (Gwethe and Kabaung reserves in 1906–7)	,,
	1907–1910	,,	Henzada	,,
	1908–1909	,,	Bassein	,,
	1911–1912	,,	Pegu, Shwegyin	,,

Name	Year of flowering	Authority	Locality of flowering	Notes
Cephalastachyum pegracile Munro	1912–1913	Troup ...	Toungoo, Rangoon, Thayetmyo, and Mimbu forest divisions	Gregarious.
	1913-1914	,, ...	Parts of Zigon, Tharrawaddy, Rangoon, Upper Chindwin, Myittha, Mu, Yaw, and Katha forest divisions	,,
	1914–1915	,, ...	Parts of Zigon, Shwegyin, and Mansi forest divisions	,,
	1915–1916	,, ...	Myaunglebin, Pegu, W. Salween, and S. Shan States forest divisions	,,
	1916–1917		Nyaunglebin, Pegu, W. Salween, and Mansi forest divisions	Gregarious. 'May be found almost any year sporadically but not generally producing good seed on such occasion.' (Gamble). 'Flowers frequently, at times gregariously over large areas.' (Brandis). 'Partial flowering every year.' (H. de L.)
Chusquea abietifolia Griseb. ...	1884	H. de L. ...	Kew ...	.. ...
,, Muelleri Munro ...	1853	,,	Mexico ...	......
	1857	,,	,,	......
,, pallida Munro ...	1844	,,		
Dendrocalamus Brandisii Kurz	1862	Brandis ...	Burma ...	'Flowers sporadically as well as gregariously.' (Troup).
	1871	Kurz ...	,,	'Flowers frequently.' (Brandis).
	1880	Brandis ...	,,	......
	1890	Oliver ...	Ruby Mines Dist. ...	......
	1894	,,	,, ,, ...	......

		1914	Troup ...	Thaungyin forests ...	Gregarious.
		1916	,, ...	Lower Chindwin ...	Gregarious. 'Said to flower sporadically and not to die off after flowering, but Oliver says that flowering clumps which he has observed showed every appearance of being about to die.' (Gamble).
,,	calostachyus Kurz	1868	J. Anderson ...	Poneshee, Bhamo (Upper Burma)	
		1875	,,	Yunan ...	......
,,	collettianus Gamble	1892	Abdul Huk ...	Upper Burma ...	......
,,	flagellifer Munro	1879	Beddome ...	Moolyet (Malay Penins.)	
,,	giganteus Munro	1860-1861	Gamble ...	Bot. Gard. Calcutta ...	Villagers in the Irrawaddy Delta estimated the age of flowering at 40 years. Offsets flower later than the parents. (Troup).
		1888	Gamble ...	,, ,,	
		1892	,,	Burma ...	......
		1893	H. Jackson ...	S. Shan States ...	......
		1897	Gamble ...	Burma ...	......
		1899	Brandis ...		
,,	Hamiltonii Nees & Arn.	1894	Gamble ...	Sikkim, Dehra Dun (cult.)	Gregarious.
		1907	H. de L. ...	India ...	.....
		1912	Troup ...	N. parts of the Khasia Hills	Gregarious.
		1910	,,	Ruby Mines Dist. (Upper Burma)	,,
		1911	,,	Ruby Mines Dist. (Upper Burma)	,,
		1914	,,	Ruby Mines Dist. (Upper Burma)	,,
		1916	,,	Myittha forest division (Upper Burma)	,,

Name	Year of flowering	Authority	Locality of flowering	Notes
Cephalastachyum pergracile Munro	1912-1913	Troup ...	Toungoo, Rangoon, Thayetmyo, and Mimbu forest divisions	Gregarious.
	1913-1914	,, ...	Parts of Zigon, Tharrawaddy, Rangoon, Upper Chindwin, Myittha, Mu, Yaw, and Katha forest divisions	,,
	1914-1915	,, ...	Parts of Zigon, Shwegyin, and Mansi forest divisions	,,
	1915-1916	,, ...	Myaunglebin, Pegu, W. Salween, and S. Shan States forest divisions	,,
	1916-1917		Nyaunglebin, Pegu, W. Salween, and Mansi forest divisions	Gregarious. 'May be found almost any year sporadically but not generally producing good seed on such occasion.' (Gamble). 'Flowers frequently, at times gregariously over large areas.' (Brandis). 'Partial flowering every year.' (H. de L.)
Chusquea abietifolia Griseb. ...	1884	H. de L. ...	Kew ...	.. ...
,, Muelleri Munro ...	1853	,, ...	Mexico ...	......
	1857	,, ...	,,	......
,, pallida Munro ...	1844	,, ...		
Dendrocalamus Brandisii Kurz	1862	Brandis ...	Burma ...	'Flowers sporadically as well as gregariously.' (Troup).
	1871	Kurz ...	,,	'Flowers frequently.' (Brandis).
	1880	Brandis ...	,,	......
	1890	Oliver ...	Ruby Mines Dist. ...	......
	1894	,, ...	,, ,, ...	......
	1914	Troup ...	Thaungyin forests ...	Gregarious.
	1916	,, ...	Lower Chindwin ...	Gregarious. 'Said to flower sporadically and not to die off after flowering, but Oliver says that flowering clumps which he has observed showed every appearance of being about to die.' (Gamble).
,, calostachyus Kurz	1868	J. Anderson ...	Poneshee, Bhamo (Upper Burma)	
	1875	,,	Yunan ...	......
,, collettianus Gamble	1892	Abdul Huk ...	Upper Burma ...	......
,, flagellifer Munro	1879	Beddome ...	Moolyet (Malay Penins.)	
,, giganteus Munro	1860-1861	Gamble ...	Bot. Gard. Calcutta ...	Villagers in the Irrawaddy Delta estimated the age of flowering at 40 years. Offsets flower later than the parents. (Troup).
	1888	Gamble ...	,, ,,	......
	1892	,,	Burma ...	.. ...
	1893	H. Jackson ...	S. Shan States ...	......
	1897	Gamble ...	Burma ...	
	1899	Brandis ...		
,, Hamiltonii Nees & Arn.	1894	Gamble ...	Sikkim, Dehra Dun (cult.)	Gregarious.
	1907	H. de L. ...	India ...	.....
	1912	Troup ...	N. parts of the Khasia Hills	Gregarious.
	1910	,,	Ruby Mines Dist. (Upper Burma)	,,
	1911	,,	Ruby Mines Dist. (Upper Burma)	,,
	1914	,,	Ruby Mines Dist. (Upper Burma)	,,
	1916	,,	Myittha forest division (Upper Burma)	,,

Name	Year of flowering	Authority	Locality of flowering	Notes
Dendrocalamus Hamiltonii Nees & Arn.	1917	Troup	Myitkyina (Upper Burma)	Gregarious.
				'Periodically at long intervals.' (Parker). 'Flowers every year.' (Hook. f.). 'Flowers sporadically and at times gregariously.' (Brandis).
,, hirtellus Ridley	1915	Ridley	Malay Peninsula	......
,, Hookeri Munro	1850	Hook. f.	Khasia Hills	......
	1881	E.E. Fernandez	Naini Tal	......
,, latiflorus Munro	1894	G. King	Laikaw (S. Shan States)	
,, longifimbriatus Gamble	1891	Gamble	Mergui Dist. (Tenasserim)	
,, longispathus Kurz	1862	D. B. Zamayi	Pegu	'Flowers frequently.' (Brandis).
	1871	Kurz	,,	'Often found flowering sporadically.' (Troup).
	1875	...	Tharawadi, Pegu	......
	1876	Lister	Chittagong	......
	1879	Gamble	,,	Gregarious.
	1880	,,	,,	......
	1885	R. Ellis	,,	......
	1887	Troup	Tharrawaddy Dist. (Burma)	Gregarious.
	1891	Carter	Burma	......
	1912	Troup	Parts of the Minhla, Mokka and Kandinbilin forests and elsewhere	Gregarious.
	1913	,,	Toungoo Dist.	,,
,, macroculmis H. de L.	1872	H. de L.	...	......

,,	membranaceus Munro	1827	Wallich ...	Martaban ...		......
		1857	Brandis ...	Yonzalin Valley ...		......
		1862	,, ...	,, ..		......
		1871	Kurz ...	In the Yomas ...		......
		1879	Beddome ...	Tenasserim ...		......
		1890	Oliver ...	Wuntho and Pinhwe forests		......
		About 1912	Troup ...	Ruby Mines Dist. ...	Gregarious.	
		1915	,, ...	Shwegyin ..	,,	
,,	patellaris Gamble	1890	Sri Gopal Banerji ...	Naga Hills ...		......
,,	sikkimensis Gamble	1885	Gamble ...	Nilgiris, cultivated ...		......
		1916	Troup ...	Kalimpong ...	Gregarious.	
,,	strictus Nees ...	1865	Gamble ...	Central Provinces ...	,,	
		About 1865	Troup ...	Tharrawaddy (Burma)	,,	
		1870	Brandis ...	Garhwal ...	,,	
		1872-1876	Troup ...	Garhwal outer Himal. tract	,,	
		1879	Gamble ...	Garhwal ...	,,	
		1880	Troup ...	Oudh ...	,,	
		1883-1886	A. F. Broun ..	Saharanpur Siwaliks ...	,,	
		1887	Gamble ...	Kurnool (Madras Pres.)	,,	
		1888	Troup ...	Tharrawaddy (Burma)	,,	
		1890	Gamble ...	Golgonda Hills (Madras Pres.)	,,	
		1891	,, ...	North Arcot ...	,,	
		1894	Troup ...	Coimbatore (Pollachi range)	,,	
		1895	,, ...	Tharrawaddy (Burma)	,,	
		1897	,, ...	Coimbatore (part of Walayar forest.)	,,	
		1899	,, ...	Seoni (C. P.) ...	,,	
		1900	,, ...	Balaghat (C. P.) ...	,,	

Name	Year of flowering	Authority	Locality of flowering	Notes
Dendrocalamus Hamiltonii Nees & Arn.	1917	Troup	Myitkyina (Upper Burma)	Gregarious.
				'Periodically at long intervals.' (Parker). 'Flowers every year.' (Hook. f.). 'Flowers sporadically and at times gregariously.' (Brandis)
,, hirtellus Ridley	1915	Ridley	Malay Peninsula	.....
,, Hookeri Munro	1850	Hook. f.	Khasia Hills	. ..
	1881	E.E. Fernandez	Naini Tal	.....
,, latiflorus Munro	1894	G. King	Laikaw (S. Shan States)	
, longifimbriatus Gamble	1891	Gamble	Mergui Dist. (Tenasserim)	
,, longispathus Kurz	1862	D. B. Zamayi	Pegu	'Flowers frequently.' (Brandis).
	1871	Kurz	,,	'Often found flowering sporadically.' (Troup).
	1875		Tharawadi, Pegu	......
	1876	Lister	Chittagong	......
	1879	Gamble	,,	Gregarious.
	1880	,,	,,	......
	1885	R. Ellis	,,	......
	1887	Troup	Tharrawaddy Dist. (Burma)	Gregarious.
	1891	Carter	Burma	......
	1912	Troup	Parts of the Minhla, Mokka and Kandinbilin forests and elsewhere	Gregarious.
	1913	,,	Toungoo Dist.	,,
,, macroculmis H. de L.	1872	H. de L.	...	......
,, membranaceus Munro	1827	Wallich	Martaban	......
	1857	Brandis	Yonzalin Valley	......
	1862	,,	,,	......
	1871	Kurz	In the Yomas	......
	1879	Beddome	Tenasserim	.. ...
	1890	Oliver	Wuntho and Pinhwe forests	...
	About 1912	Troup	Ruby Mines Dist.	Gregarious.
	1915	,,	Shwegyin	,,
,, patellaris Gamble	1890	Sri Gopal Banerji	Naga Hills	......
,, sikkimensis Gamble	1885	Gamble	Nilgiris, cultivated	......
	1916	Troup	Kalimpong	Gregarious.
,, strictus Nees	1865	Gamble	Central Provinces	,,
	About 1865	Troup	Tharrawaddy (Burma)	,,
	1870	Brandis	Garhwal	,,
	1872–1876	Troup	Garhwal outer Himal. tract	,,
	1879	Gamble	Garhwal	,,
	1880	Troup	Oudh	,,
	1883–1886	A. F. Broun	Saharanpur Siwaliks	,,
	1887	Gamble	Kurnool (Madras Pres.)	,,
	1888	Troup	Tharrawaddy (Burma)	,,
	1890	Gamble	Golgonda Hills (Madras Pres.)	,,
	1891	,,	North Arcot	,,
	1894	Troup	Coimbatore (Pollachi range)	,,
	1895	,,	Tharrawaddy (Burma)	,,
	1897	,,	Coimbatore (part of Walayar forest.)	,,
	1899	,,	Seoni (C. P.)	,,
	1900	,,	Balaghat (C. P.)	,,

Name	Year of flowering	Authority	Locality of flowering	Notes
Dendrocalamus strictus Nees...	1900–1901	Troup ...	S. Chanda (C. P.) ...	Gregarious.
	1901	,, ...	Thana (Bombay Pres.)	,,
	1902	Bruce ...	Ruby Mines Dist. ...	,,
	1906	Troup ...	Thayetmyo (Burma) ...	,,
	1907–1908	H. de L. ...	Europe ...	
	1908	Troup ...	Nimar (C. P.) ...	Partial.
	1908	,, ...	Henzada (Burma) ...	Gregarious.
	1908–1913	,, ...	Garhwal outer Himal. tract	,,
	1909	,, ...	Henzada (Burma) ...	,,
	1911	,, ...	Bundelkhand (U. P.)	,,
	1911–1912	,, ...	Ruby Mines (Burma)	,,
	1912–1913	,, ...	Tharrawaddy (Burma)	,,
	1911–1913	,, ...	Mu forest division (Burma)	,,
	1914	,, ...	Burma ...	Gregarious. '**C**ommonly flowers sporadically, in isolated clumps or in small groups, almost every year; it also flowers gregariously over large tracts at long intervals, the gregarious flowering usually taking some years to complete, and often progressing in a definite direction in successive years. Actually it is often difficult to distinguish between sporadic flowering on a plentiful scale and gregarious flowering, there being all stages between the two. In the Garhwal outer Himalayan tract the interval between the last two recorded general flowerings was between 36 and 40 years (i.e., 1872–1876 and 1908–1913). (Troup).

				According to Smythies the interval in the Chanda Distr. is about 30 years. Life-cycle between 30 and 40 years. (Troup).
,, strictus var. sericea Gamble	1858, 1871 ?	Thomson, Kurz	Mt. Parasnath	......
Dinochloa andamanica Kurz	1858	Sieber	Andamans	......
	1874	A. L. Home	,,	......
	1875	Kurz	,,	......
	1875	,,	Nicobars	......
Gigantochloa compressa Parker	1925–1926	Parker	Tenasserim	Gregariously in patches.
	1927	,,	,,	A very few clumps in flower.
,, Kurzii Gamble	1878	Kurz	,,	......
	1892	Ridley	Perak	......
,, latispiculata Gamble	1886	Alwis	Malacca	......
,, ligulata Gamble	1891	Ridley	Kwala Pahan (Malay Pen.)	......
,, macrostachya Kurz	1862	Brandis	Sittang Hills	......
	1869	Kurz	Arakan	......
	1871	,,	,,	......
	1879	Schlich, Gamble	Chittagong	......
,, Scortechini Gamble	1886	Scortechini	Malay Pen.	......
	1889	L. Wray	Upper Perak	......
,, Wrayi Gamble	1888	,,	Perak	......
Glaziophyton mirabile Franchet	1888	H. de L.	? (Native of Brazil)	......
Melocalamus compactiflorus Benth. & Hook.	1871	Kurz	Martaban, Karen Hills	‘ Flowers frequently.’ (Brandis).
Melocanna bambusoides Trin.	1811	Brandis	Chittagong	......
	1863–1866	Gamble	Chittagong, Arakan, Bot. G. Calcutta	Gregarious.
	1889	,,	Garo and Khasia Hills	,,
	1892	Troup	Assam	,,

Name	Year of flowering	Authority	Locality of flowering	Notes
Dendrocalamus strictus Nees	1900–1901	Troup	S. Chanda (C. P.)	Gregarious.
	1901	,,	Thana (Bombay Pres.)	,,
	1902	Bruce	Ruby Mines Dist.	,,
	1906	Troup	Thayetmyo (Burma)	,,
	1907–1908	H. de L.	Europe	
	1908	Troup	Nimar (C. P.)	Partial
	1908	,,	Henzada (Burma)	Gregarious.
	1908–1913	,,	Garhwal outer Himal. tract	,,
	1909	,,	Henzada (Burma)	,,
	1911	,,	Bundelkhand (U. P.)	,,
	1911–1912	,,	Ruby Mines (Burma)	,,
	1912–1913	,,	Tharrawaddy (Burma)	,,
	1911–1913	,,	Mu forest division (Burma)	,,
	1914	,,	Burma	Gregarious. 'Commonly flowers sporadically, in isolated clumps or in small groups, almost every year; it also flowers gregariously over large tracts at long intervals, the gregarious flowering usually taking some years to complete, and often progressing in a definite direction in successive years. Actually it is often difficult to distinguish between sporadic flowering on a plentiful scale and gregarious flowering, there being all stages between the two. In the Garhwal outer Himalayan tract the interval between the last two recorded general flowerings was between 36 and 40 years (i.e., 1872–1876 and 1908–1913). (Troup). According to Smythies the interval in the Chanda Distr. is about 30 years. Life-cycle between 30 and 40 years. (Troup).
,, strictus var. sericea Gamble	1858, 1871 ?	Thomson, Kurz	Mt. Parasnath	......
Dinochloa andamanica Kurz	1858	Sieber	Andamans	.. ..
	1874	A. L. Home	,,	..
	1875	Kurz	,,	......
	1875	,,	Nicobars	......
Gigantochloa compressa Parker	1925–1926	Parker	Tenasserim	Gregariously in patches.
	1927	,,	,,	A very few clumps in flower.
,, Kurzii Gamble	1878	Kurz	,,	......
	1892	Ridley	Perak	......
,, latispiculata Gamble	1886	Alwis	Malacca	.....
,, ligulata Gamble	1891	Ridley	Kwala Pahan (Malay Pen.)	......
,, macrostachya Kurz	1862	Brandis	Sittang Hills	......
	1869	Kurz	Arakan	.. ...
	1871	,,	,,	......
	1879	Schlich, Gamble	Chittagong	......
,, Scortechini Gamble	1886	Scortechini	Malay Pen.	......
	1889	L. Wray	Upper Perak	......
,, Wrayi Gamble	1888	,,	Perak	.....
Glaziophyton mirabile Franchet	1888	H. de L.	? (Native of Brazil)	......
Melocalamus compactiflorus Benth. & Hook.	1871	Kurz	Martaban, Karen Hills	'Flowers frequently.' (Brandis).
Melocanna bambusoides Trin.	1811	Brandis	Chittagong	......
	1863–1866	Gamble	Chittagong, Arakan, Bot. G. Calcutta	Gregarious.
	1889	,,	Garo and Khasia Hills	,,
	1892	Troup	Assam	,,

Name	Year of flowering	Authority	Locality of flowering	Notes
Melocanna bambusoides Trin.	1900, 1902	Troup	Garo and Khasia Hills	Gregarious.
	1901, 1902, 1904, 1905	,,	Chittagong, Arakan	Apparently over restricted areas.
	1908–1912	,,	Chittagong	Extensive flowering.
	1909–1910	H. de L.	Calcutta Bot. Gard. (cultivated)	......
	1910–1913	Troup	Arakan	'Extensive flowering, spreading in 1912–1913 to the east side of the Yoma into the Prome, Henzada, and Bassein districts.' (Troup).
	1910–1911	,,	Sylhet (Assam)	Gregarious.
	1911–1912	,,	Garo Hills, Cachar, Sylhet, Lushai Hills (Assam)	,,
	1912–1913	,,	Bamonpokri plantation (Kurseong)	......
	1915–1916	,,	Arakan	Gregarious. Period according to Gamble about 30 years, according to Kurz 30–35 years, according to Troup about 45 years. 'The data at present available are not sufficient to justify any definite conclusions.'
Merostachys capitata Hook.	1867, 1873, 1878	H. de L.	Brazil	......
,, Clausseni Munro	1878	,,	,,	......
,, Fischeriana Rupr.	1842	,,	,,	......
,, Kunthiana Poir.	1905	,,	,,	......
,, Neesii Rupr.	1840	,,	,,	......
,, petiolata Denstedt	1874	,,	,,	......
,, racemiflora Fourr.	1841	,,	,,	......
Neohouzeaua Dullooa A. Camus	1880	Fuchs	Brit. Bhutan	......
	1889	Gammie	,,	......
	1892	Oliver	Katha Distr. (Upper Burma)	......

	1892–1893	Gamble ...	Momeik State (Burma)	......
	1894	Oliver ...	Ruby Mines Distr. (Burma)	......
,, Helferi Gamble ...	1889	Mann ...	Garo Hills (Assam) ...	......
	1922	Dickins ...	Toungoo Distr.(Burma)	......
,, stricta Parker ...	1925–1926	Parker ...	Tenasserim ...	Gregarious.
	1927	,, ...	,, ...	A few clumps in flower.
,, tavoyana Gamble	1919	C. G. Rogers ...	Sinyat. Hill in Tavoy...	......
Ochlandra Beddomei Gamble...	1875–1876	Brandis ...	Sisbara Ghat ...	Died after flowering. 'Had not been known to flower for 20 years.' (Brandis).
,, Brandisii Gamble ...	1835	Wight ...	Tinnevelly Ghats ...	......
	1882	Brandis ...	,, ...	......
,, Rheedei Benth. & Hook. f. ...	...	...	...	Flowers annually, not dying down after flowering. (Bourdillon).
,, Ridleyi Gamble ...	1892	J. Feilding ...	Singapore ...	......
,, stridula Thw. ...	Annually	...	...	Flowers annually and regularly. (Trimen). Does not die down after flowering. (Brandis).
,, Talboti Brandis ...	1896	Brandis ...	Throughout N. Kanara	Had not been seen in flower for many years in that district. (Brandis).
,, travancorica Benth..	1868	Beddome ...	...	'Believed to die down after flowering.' (Brandis).
	1875	Bourdillon ...	Travancore ...	'It flowers almost every 7 years and dies down.' (Bourdillon).
	1882	Brandis ...	Tinnevelly Ghats ...	'Flowers annually.' Bourdillon ex H. de L.
	1905	Camus ...	Travancore ...	......
Oreiostachys Pullei Gamble ...	...	...	...	Flowers rarely (H. de. L.)
Oxytenanthera abyssinica Munro	1865	H. de L. ...	Trop. Africa ...	......
	1918–1919	Henkel ...	Southern Rhodesia ...	Gregarious, all the old plants died.
	1924–1925	,, ...	,, ...	'The life-cycle appears to be about 30 years. Plants reproduced from branches of the rhizome flower and die at the same time as the parent plant.' (Henkel).

Name	Year of flowering	Authority	Locality of flowering	Notes
Melocanna bambusoides Trin.	1900, 1902	Troup	Garo and Khasia Hills	Gregarious.
	1901, 1902, 1904, 1905	,,	Chittagong, Arakan	Apparently over restricted areas.
	1908–1912	,,	Chittagong	Extensive flowering.
	1909–1910	H. de L.	Calcutta Bot. Gard. (cultivated)	......
	1910–1913	Troup	Arakan	'Extensive flowering, spreading in 1912–1913 to the east side of the Yoma into the Prome, Henzada, and Bassein districts.' (Troup).
	1910–1911	,,	Sylhet (Assam)	Gregarious.
	1911–1912	,,	Garo Hills, Cachar, Sylhet, Lushai Hills (Assam)	,,
	1912–1913	,,	Bamonpokri plantation (Kurseong)	......
	1915–1916	,,	Arakan	Gregarious. Period according to Gamble about 30 years, according to Kurz 30–35 years, according to Troup about 45 years. 'The data at present available are not sufficient to justify any definite conclusions.'
Merostachys capitata Hook.	1867, 1873, 1878	H. de L.	Brazil	......
,, Clausseni Munro	1878	,,	,,	.....
,, Fischeriana Rupr.	1842	,,	,,	.....
,, Kunthiana Poir.	1905	,,	,,	....
,, Neesii Rupr.	1840	,,	,,	.....
,, petiolata Denstedt	1874	,,	,,	.....
,, racemiflora Fourn.	1841	,,		.....
Neohouzeaua Dullooa A. Camus	1880	Fuchs	Brit. Bhutan	....
	1889	Gammie	,,	......
	1892	Oliver	Katha Distr. (Upper Burma)	......
	1892–1893	Gamble	Momeik State (Burma)	......
	1894	Oliver	Ruby Mines Distr. (Burma)	......
,, Helferi Gamble	1889	Mann	Garo Hills (Assam)	......
	1922	Dickins	Toungoo Distr. (Burma)	......
,, stricta Parker	1925–1926	Parker	Tenasserim	Gregarious.
	1927	,,	,,	A few clumps in flower.
,, tavoyana Gamble	1919	C. G. Rogers	Sinyat. Hill in Tavoy	......
Ochlandra Beddomei Gamble	1875–1876	Brandis	Sisbara Ghat	Died after flowering. 'Had not been known to flower for 20 years.' (Brandis).
,, Brandisii Gamble	1835	Wight	Tinnevelly Ghats	......
	1882	Brandis	,,	......
,, Rheedei Benth. & Hook. f.	...	...	...	Flowers annually, not dying down after flowering. (Bourdillon).
,, Ridleyi Gamble	1892	J. Feilding	Singapore	......
,, stridula Thw.	Annually	...	...	Flowers annually and regularly. (Trimen). Does not die down after flowering. (Brandis).
,, Talboti Brandis	1896	Brandis	Throughout N. Kanara	Had not been seen in flower for many years in that district. (Brandis).
,, travancorica Benth.	1868	Beddome	...	'Believed to die down after flowering.' (Brandis).
	1875	Bourdillon	Travancore	'It flowers almost every 7 years and dies down.' (Bourdillon).
	1882	Brandis	Tinnevelly Ghats	'Flowers annually.' Bourdillon ex H. de L.
	1905	Camus	Travancore	......
Oreiostachys Pullei Gamble	...	...	...	Flowers rarely (H. de. L.)
Oxytenanthera abyssinica Munro	1865	H. de L.	Trop. Africa	......
	1918–1919	Henkel	Southern Rhodesia	Gregarious, all the old plants died. 'The life-cycle appears to be about 30 years. Plants reproduced from branches of the rhizome flower and die at the same time as the parent plant.' (Henkel).
	1924–1925	,,	,,	

Name	Year of flowering	Authority	Locality of flowering	Notes
Oxytenanthera albociliata Munro	1857	Mason	Toungoo Hills (Burma)	'Irregularly flowering.' (Brandis).
	1871	Kurz	Thaungyin and Pegu Yomas	'Often flowers sporadically.' (Troup).
	1880	Brandis	Houndraw valley, Toungnyo	......
	1891	Oliver	Pyinmana (Burma)	......
	1892	McHarg	Tenasserim	......
	1900, 1901	Camus	Burma	......
	1909	H. de L.	Europe	......
	1911	Troup	Pyinmana (Burma)	Gregarious.
	1912	,,	Thayetmyo (Burma)	,,
	1913	,,	Toungoo (Burma)	,,
	1914	,,	S. Toungoo, Shwegyin, Rangoon	,,
	1916	,,	N. Toungoo, Thaungyin forests	,,
	1917	,,	Zigon, Tharrawaddy, W. Salween	,,
,, Borzii Mattei ...	1909	H. de L.	Eritrea	......
,, Bourdilloni Gamble	1889	Bourdillon	...	'Flowers at long intervals.' (Brandis).
,, nigrociliata Munro	1849	Falconer	Tenasserim	'Often flowers sporadically.' (Troup).
	1875	A. L. Home	Andamans	......
	1879	King	Moulmein	......
,, parvifolia Brandis	1880	Brandis	Yonzalin Valley (Burma)	......
,, Ritcheyi Blatter	1852	Ritchie	Kala Nuddi	......
	1870	Brandis	Satara Ghats	......
	1884	Talbot	N. Kanara	......
	1889	,,	,,	......
	1892	R. S. Fagan	Mahableshwar	......

	1892	A. D. Wilkins	Ahmednagar	......
,, sinuata Gamble	1885	Gamble	Serumban (Malay Pen.)	......
,, Stocksii Munro	1884	Talbot	Kumpta river (N. Kanara)	......
	1889	,,	Karwar (N. Kanara)	......
,, Thwaitesii Munro	1847	Wight	Nilgiris	Very frequently in flower. Gamble is not sure that it dies down after flowering.
	1851	,,	Nilgiris	......
	1865	Beddome	Anamalais	......
	1870	Clarke	Coonoor	......
	1871	Beddome	Anamalais	......
	1878	King	Ochterlony Valley	......
	1883	Gamble	Various places	......
	1889	,,	,,	......
Phyllostachys aurea Carrière	1876	Bean	Florence	......
	1904	H. de L.	Belgium (native of China and Japan)	......
	1905	Bean	British Isles	......
,, bambusoides S. & Z.	1843(?)	Siebold	Japan	......
	1900, 1904	Makino	,,	......
,, bambusoides var. Castilloni	1903, 1904	Camus	Kew (native of China)	......
,, congesta Rendle	1878	H. de L.	China	......
,, Faberi Rendle	1888	,,	,,	......
,, flexuosa A. & C. Riv.	1876	Rivière	Toulon, Paris, Hamma (Algiers)	Brought from China in 1864.
,, mitis Rivière	1856	H. de L.	Algeria (native of China)	......
,, nana Rendle	1887	Rendle	China	......
,, Nevinii Hance	1876	H. de L.		......
,, nidularia Munro	1875	Camus		......
	1887	H. de L.	Florence (native of Japan)	......
,, puberula Mak.	1889, 1900	,,	Japan	......
	1898	Bean	Sussex	......
	1900, 1906	H. de L.	Europe (native of Japan)	......
	1900	Bean	Near Bristol	......

Name	Year of flowering	Authority	Locality of flowering	Notes
Oxytenanthera albociliata Munro	1857	Mason	Toungoo Hills (Burma)	'Irregularly flowering.' (Brandis).
	1871	Kurz	Thaungyin and Pegu Yomas	'Often flowers sporadically.' (Troup).
	1880	Brandis	Houndraw valley, Toungnyo	......
	1891	Oliver	Pyinmana (Burma)	......
	1892	McHarg	Tenasserim	......
	1900, 1901	Camus	Burma	......
	1909	H. de L.	Europe	......
	1911	Troup	Pyinmana (Burma)	Gregarious.
	1912	,,	Thayetmyo (Burma)	,,
	1913	,,	Toungoo (Burma)	,,
	1914	,,	S. Toungoo, Shwegyin, Rangoon	,,
	1916	,,	N. Toungoo, Thaungyin forests	,,
	1917	,,	Zigon, Tharrawaddy, W. Salween	,,
,, Borzii Mattei	1909	H. de L.	Eritrea	......
,, Bourdilloni Gamble	1889	Bourdillon	...	'Flowers at long intervals.' (Brandis).
,, nigrociliata Munro	1849	Falconer	Tenasserim	'Often flowers sporadically.' (Troup).
	1875	A. L. Home	Andamans	......
	1879	King	Moulmein	......
,, parvifolia Brandis	1880	Brandis	Yonzalin Valley (Burma)	......
,, Ritcheyi Blatter	1852	Ritchie	Kala Nuddi	......
	1870	Brandis	Satara Ghats	......
	1884	Talbot	N. Kanara	......
	1889	,,	,,	......
	1892	R. S. Fagan	Mahableshwar	......
	1892	A. D. Wilkins	Ahmednagar	......
,, sinuata Gamble	1885	Gamble	Serumban (Malay Pen.)	......
,, Stocksii Munro	1884	Talbot	Kumpta river (N. Kanara)	......
	1889	,,	Karwar (N. Kanara)	......
,, Thwaitesii Munro	1847	Wight	Nilgiris	Very frequently in flower. Gamble is not sure that it dies down after flowering.
	1851	,,	Nilgiris	......
	1865	Beddome	Anamalais	......
	1870	Clarke	Coonoor	......
	1871	Beddome	Anamalais	......
	1878	King	Ochterlony Valley	......
	1883	Gamble	Various places	......
	1889	,,	,,	......
Phyllostachys aurea Carrière	1876	Bean	Florence	......
	1904	H. de L.	Belgium (native of China and Japan)	......
	1905	Bean	British Isles	......
,, bambusoides S. & Z.	1843(?)	Siebold	Japan	......
	1900, 1904	Makino	,,	......
,, bambusoides var. Castilloni	1903, 1904	Camus	Kew (native of China)	......
,, congesta Rendle	1878	H. de L.	China	......
,, Faberi Rendle	1888	,,	,,	......
,, flexuosa A. & C. Riv.	1876	Rivière	Toulon, Paris, Hamma (Algiers)	Brought from China in 1864
,, mitis Rivière	1856	H. de L.	Algeria (native of China)	......
,, nana Rendle	1887	Rendle	China	......
,, Nevinii Hance	1876	H. de L.		......
,, nidularia Munro	1875	Camus		......
	1887	H. de L.	Florence (native of Japan)	....
,, puberula Mak.	1889, 1900	,,	Japan	....
	1898	Bean	Sussex	..
	1900, 1906	H. de L.	Europe (native of Japan)	...
	1900	Bean	Near Bristol	......

Name	Year of flowering	Authority	Locality of flowering	Notes
Phyllostachys puberula Mak ...	1902, 1903–1905	Bean ...	Kew ...	In Temperate House in 1902, in open air 1903-1905. All plants died.
,, puberula var. Boryana H. de L.	1903	,, ...	Exeter, native of China	......
	1904	,, ...	Kew ...	Entire plant died, with the exception of a small portion. (Bean).
,, puberula var. fulva H. de L.	1905	,, ...	,,	......
,, puberula var. nana H. de L.	1904	H. de L. ...	,,	......
	1901	,, ...	Japan ...	......
,, puberula var. nigro-punctata H. de L.	1900	Bean ...	Japan, England, all over Europe	During the next few years after 1900 other plants flowered at Kew and many other gardens. (Bean).
	1903	H. de L. ...	Kew and all over Europe	......
,, pubescens H. de L.	1900	,, ...	Japan ...	......
,, Stauntonii Munro ...	1898	Staunton ...	China ...	......
Pseudostachyum polymorphum Munro	1857	Thomson ...	Sikkim ...	Flowers frequently. (Brandis).
	1891	Gammie ...	,, ...	......
Sasa albo-marginata Mak.	1886	H. de. L. ...	Japan ...	......
,, auricoma E. G. Camus ...	Annually	Bean ...	Kew ...	Only few culms flower and die; plants not affected.
,, japonica Mak. ...	1867, 1868	Camus ...	Algeria, Paris, Marseilles (native of Japan)	Offsets of a parent plant introduced into Europe in 1850.
	1872, 1874	Bean ...	England and Florence	......
	1877, 1880, 1886, 1898	Camus ...	Japan ...	......
,, spiculosa Mak. ...	1893–1894	H. de L. ...	,, ...	......
Schizostachyum aciculare Gamble	1885	Alwys ...	Rupayoong (Malay Pen.)	......
,, Blumei Nees...	1889	Ridley ...	Singapore ...	......

,, brachycladum Kurz	1898	H. de L.	...	......
,, elegans Ridley	1915	Ridley	Malay Peninsula	......
,, latifolium Gamble	1891	,,	Pahang (Malay Pen.)	......
,, tenue Gamble	1891	,,	,, ,,	......
Teinostachyum attenuatum Munro	1864	Thwaites	Ceylon C.P.	......
	1890	Trimen	Ohiya Valley (Ceylon)	......
,, Griffithii Munro	1883, 1884	Gamble	Travancore	......
	1887–1889	Bourdillon	,,	......
	1889	Mann	Assam	......
,, Wightii Bedd.	1883, 1884	Gamble	Sispara Ghat	......
	1887	Bourdillon	Peermaad	......
	1887–1889	,,	Travancore	Flowered and died off.
Thyrsostachys Oliveri Gamble	1891	Gamble	Upper Burma	Gregarious.
	1902–1905	Troup	Ruby Mines	Sporadic.
	1911–1912	,,	Thabeitkyin subdivision of the Ruby Mines Dist.	Gregarious. ,,
	1914	,,	Ruby Mines, Mandalay, and Meiktila Districts	,,
	1916	,,	S. Shan States	,,
	1916	,,	Henzada-Maubin	Sporadic.
	1917	,,	Mandalay Dist.	Gregarious.
,, siamensis Gamble	1892	Gamble	Calcutta Bot. Gard.	Flowers periodically. (Brandis).
	1893	Brandis	,, ,,	A few flowers on thin wiry branchlets.

(*To be continued.*)

Name	Year of flowering	Authority	Locality of flowering	Notes
Phyllostachys puberula Mak ...	1902, 1903–1905	Bean	Kew	In Temperate House in 1902, in open air 1903-1905. All plants died.
,, puberula var. Boryana H. de L.	1903	,,	Exeter, native of China	......
	1904	,,	Kew	Entire plant died, with the exception of a small portion. (Bean).
,, puberula var. fulva H. de L.	1905	,,	,,	......
,, puberula var. nana H. de L.	1904	H. de L.	,,	.. ..
	1901	,,	Japan	..
,, puberula var. nigropunctata H. de L.	1900	Bean	Japan, England, all over Europe	During the next few years after 1900 other plants flowered at Kew and many other gardens. (Bean).
	1903	H. de L.	Kew and all over Europe	......
,, pubescens H. de L.	1900	,,	Japan	......
,, Stauntonii Munro ...	1898	Staunton	China	......
Pseudostachyum polymorphum Munro	1857	Thomson	Sikkim	Flowers frequently. (Brandis).
	1891	Gammie	,,	......
Sasa albo-marginata Mak.	1886	H. de. L.	Japan	......
,, auricoma E. G. Camus ...	Annually	Bean	Kew	Only few culms flower and die; plants not affected.
,, japonica Mak. ...	1867, 1868	Camus	Algeria, Paris, Marseilles (native of Japan)	Offsets of a parent plant introduced into Europe in 1850.
	1872, 1874	Bean	England and Florence	......
	1877, 1880, 1886, 1898	Camus	Japan	......
,, spiculosa Mak. ...	1893–1894	H. de L.	,,	......
Schizostachyum aciculare Gamble	1885	Alwys	Rupayoong (Malay Pen.)	......
,, Blumei Nees...	1889	Ridley	Singapore	......
,, brachycladum Kurz	1898	H. de L.	...	......
,, elegans Ridley	1915	Ridley	Malay Peninsula	...
,, latifolium Gamble	1891	,,	Pahang (Malay Pen.)	....
,, tenue Gamble	1891	,,	,, ,,	...
Teinostachyum attenuatum Munro	1864	Thwaites	Ceylon C.P.	
	1890	Trimen	Ohiya Valley (Ceylon)	
,, Griffithii Munro	1883, 1884	Gamble	Travancore	... ..
	1887–1889	Bourdillon	,,	.. ..
	1889	Mann	Assam	......
,, Wightii Bedd	1883, 1884	Gamble	Sispara Ghat	......
	1887	Bourdillon	Peermaad	......
	1887–1889	,,	Travancore	Flowered and died off.
Thyrsostachys Oliveri Gamble	1891	Gamble	Upper Burma	Gregarious.
	1902–1905	Troup	Ruby Mines	Sporadic.
	1911–1912	,,	Thabeitkyin subdivision of the Ruby Mines Dist.	Gregarious. ,,
	1914	,,	Ruby Mines, Mandalay, and Meiktila Districts	,,
	1916	,,	S. Shan States	,,
	1916	,,	Henzada-Maubin	Sporadic.
	1917	,,	Mandalay Dist.	Gregarious.
,, siamensis Gamble	1892	Gamble	Calcutta Bot. Gard.	Flowers periodically. (Brandis).
	1893	Brandis	,, ,,	A few flowers on thin wiry branchlets.

(*To be continued.*)

THE HISTORY AND PROGRESS OF THE ZOOLOGICAL SURVEY OF INDIA

INTRODUCTION

By Lt.-Col. R. B. Seymour Sewell, I.M.S., M.A., F.A.S.B., F.L.S., F.Z.S.

It has been suggested by Sir Reginald Spence, Honorary Secretary, Bombay Natural History Society, that an article on the purpose and progress of the Zoological Survey of India might be of interest to the members of the Bombay Natural History Society, and might lead to a closer co-operation of the Society and its members with the Zoological Survey of India and its various officers and that by such close co-operation the usefulness both of the Society and of the Survey might be increased. In the following paper, therefore, I and my officers in the Survey have attempted, somewhat briefly, to bring before the members of the Bombay Natural History Society what we are attempting to do for India and what the members of the Bombay Natural History Society can do for us.

History of the Zoological Survey of India.—In order to trace the origin and history of the Zoological Survey of India it is necessary to go back nearly a hundred years, when serious zoological investigations were first undertaken in this country. At that time the only Society of any importance in India was the Asiatic Society of Bengal. This Society had been founded by Sir William Jones in 1784, but for nearly fifty years the study of zoology was not encouraged. It was at the instance of Brian Hodgson that investigation into the fauna of this country was seriously commenced, the first area to be investigated, and by Brian Hodgson himself, being the neighbouring territory of Nepal. It was in 1841 that Edward Blyth was appointed Curator of the Asiatic Society's Museum and he immediately commenced to make collections and to describe the vertebrate fauna of the Indian Empire. From this time on, a number of enthusiastic zoologists, whose names are too many to mention here, continued to carry on this work and gradually the collections of the Asiatic Society of Bengal increased and there was added to our knowledge a large number of new species, the 'types' of which were deposited in the Asiatic Society's Museum. The increase of the Society's collections resulted, in a few years, in such a congestion of the available and limited space in the Society's building that in 1856 the Society submitted a memorial to the Government of India urging the Government to establish an Imperial Museum in Calcutta, and offering their very valuable collection as a nucleus. Six years later, in 1862, the Government of India agreed to the proposal and the erection of the Indian Museum was commenced, but it was not till 1875 that the Museum building in Chowringhee was completed and the Asiatic Society's collections were transferred to their new home. At the commencement of the Indian Museum, the collections of the Zoological and Anthropological Section consisted almost entirely of the collections that had been made by the Asiatic Society of Bengal and which were handed over by the Society to the Museum to form a nucleus around and to which further additions could be made. At the same time in 1875 the Marine Survey of India was inaugurated and, again owing to the representations made by the Asiatic Society of Bengal, the post of Surgeon-Naturalist to the Marine Survey of India was created. The duties of the Marine Survey included the investigation of the marine and specially the deep-sea fauna of the Indian waters; and it was laid down that these collections were the property of the Asiatic Society of Bengal until they had been worked out and named, and when this had been done, they were to be handed over to the Indian Museum. Between 1875 and 1916 the Zoological and Anthropological Section of the Indian Museum steadily expanded and by the care and activity of successive Superintendents and Assistant Superintendents, notably Dr. J. Anderson, Mr. J. Wood-Mason, Lt.-Col. A. W. Alcock and finally Dr. N. Annandale and his colleagues, a magnificent collection of animals in many of the larger groups was got together and a number of descriptive catalogues were prepared and published. During the same period a number of very important collections made by enthusiastic and distinguished amateurs, notably those by Dr. Francis Day of Indian Fishes, Mr. L. de Niceville of Butterflies, Dudgeon and Green of Moths, van de Poll of Passalid Beetles, and Godwin-Austin of Molluscs, were offered for sale and were purchased by the Trustees with funds supplied for the purpose by the Government of India. The number of officers attached to the Zoological and Anthropological Section of the Museum rose during these years from one to four and in 1916 as a result of representations made to the Government of India by the Trustees of the Indian Museum and by Dr. N. Annandale, Superintendent of the Museum and Officer-in-charge of the Zoological and Anthropological Section, this Section of the Museum was converted into the Zoological Survey of India and was placed on an equality with the Geological and Botanical Surveys. At this period the British Empire was in the throes of the great war and the services of the baby Survey were immediately offered to the Government of India. One of the novel features of the war was the realization by the military and especially by the medical authorities of the importance of the study of zoology and the employment of professional zoologists as a means towards the prevention of disease by sanitation or towards its limitation by recognized methods of quarantine, etc.; and, as a result of this recognition, a number of zoological specialists were employed in connection with the forces. But it was not until 1918, and only then largely as a result of representations made by the then Director-General of the Indian Medical Service, Surgeon-General Edwards, I.M.S., that the Government availed themselves of the services of the Zoological Survey of India in order to carry out investigations regarding the possibility of the introduction of diseases hitherto unknown in this country, and more particularly of Schistosomiasis, by the troops returning from infected areas overseas. Another result of the war was an influx into the Museum of a number of collections made by officers who were interested in Zoology, either as amateurs or as professionals, in regions overseas to which these officers had proceeded on active service. Special attention was drawn to these valuable donations in the first report on the Zoological Survey of India for the year 1916-17, in which it was pointed out that a noteworthy feature of the donations received during this year was the large area from which they had come, 'from Egypt to Japan and from Siam to Arabia.' Commencing with this first request by the Government for the assistance of the Zoological Survey of India, co-operation between the Survey and the various Governments, either Imperial or Provincial, or with other official and non-official bodies has steadily increased and I may perhaps be allowed to refer here to the assistance that was rendered to the Bombay Natural History Society by the Zoological Survey of India during the course of the Mammal Survey that was conducted by the Society. In more recent years the Zoological Survey of India has been and is being more and more frequently consulted and asked for advice regarding such widely divergent subjects as (1) the organization of sea-fisheries by the Government of Madras, (2) brackish-water fisheries by the Government of Bihar and Orissa, (3) fresh-water fisheries by the Governments of the United Provinces and Burma, (4) the protection of lizards by the Government of Bengal, (5) the oyster fisheries in the Sunderbans by the Government of Bengal, and (6) the distribution of certain mammals, particularly those useful in medical research work, by the Calcutta School of Tropical Medicine. When asked to give advice on problems so divergent as these, it is particularly impressed on the officers of the Zoological Survey of India that, however expert we may be in certain groups of the Animal Kingdom and however extended our knowledge in the taxonomy of these groups, our knowledge of the habits of the vast majority of the animals inhabiting this country is still hopelessly incomplete and it is particularly along this line of research that enthusiastic amateurs such as the members of the Bombay Natural History Society, and particularly those members whose profession and occupation entail residence in the mofussil or in the wilds and jungles of India, can be of inestimable value.

At its inception the Zoological Survey of India consisted of only four officers, and Dr. Annandale in his first report on the Survey in 1917 wrote 'to any school-boy it must be clear that four men cannot conduct a real survey of the Indian Empire'. Since its inauguration the Survey has steadily increased in the number of its gazetted officers and at the present time 'we are seven', though even now we are still two short of our cadre as sanctioned by the Secretary of State; but it is hoped that in the near future these two vacancies will be filled and the strength of the Survey even further increased. Until this is done the actual regional survey-work of the department must be confined to comparatively small areas. The first actual surveys undertaken by the department consisted in a study of small areas such as the Inlé Lake, Chilka Lake, the mouth of the Mutlah River, the Siju Cave, etc. During the latter part of the war and as a part of our investigations regarding the possible introduction of Schistosomiasis into India, we were able to carry out investigations into the fauna of Seistan. In 1926, at the request of the Pasteur Institute, Rangoon, and again in connection with the possible introduction of Schistosomiasis into Burma, we carried out a survey, especially of the Mollusc fauna, of the Northern Shan States. But in these instances it must be borne in mind that, however intensive a study may be made of an area during a period of a few weeks or a month or two, our knowledge of the fauna of that area must still remain hopelessly incomplete and it is only by repeated investigations at different periods of the year that we can hope to obtain anything like a complete knowledge. With the increase in the strength of the department we have in recent years become rather more ambitious and at the present time we are attempting a survey of the Nerbudda River. During the last three years parties have been despatched and collections have been carefully made, commencing in the region of the headwaters of the river system at Amarkantak and its vicinity in the Rewa State, and gradually progressing further and further down the various tributaries until at the present time we have reached the neighbourhood of Itarsi. No one, however, realizes more clearly than we do that the collections made by successive parties can only give a partial picture of the fauna, since this of necessity must change very considerably from season to season and possibly from year to year in accordance with the various changes in climatic conditions during each season of the year and with the intensity in successive years of the monsoon rainfall, and it would be of the very greatest help to us if members of the Society who may happen either to live in this area, or may be visiting it, would make additional collections for us and send them to us wth full details as to the locality in which they were made, the time of the year and the general conditions existing at the time.

The first essential of any survey, such as we are attempting to carry out, is the correct identification of the various animals that may be collected, and of necessity every officer in the Zoological Survey of India has first and foremost to become a taxonomist. With only six Zoologists on the staff, the seventh being an Anthropologist, it is impossible for us to cover the whole of the Animal Kingdom, but for many years past the officers of the Zoological and Anthropological Section of the Indian Museum or of the Zoological Survey of India have each of them taken up the study of one or two larger groups and in these groups we can claim to be experts. This specialisation has enabled us in the past to carry out taxonomic surveys of a number of different groups, the results of which have been published either as separate 'catalogues' or as 'memoirs', a complete list of which is issued by the Government Central Publication Branch, 8 Hastings Street, Calcutta, and is far too long to be included here, but among others one may mention those of the Crustacea by Alcock, the fresh-water Sponges and Polyzoa by Annandale, the Stomatopoda by Kemp, the Passalid Beetles by Gravely and the Nemocera by Brunetti, and a special volume of the 'Records' on Biting Flies. We have been in the past, and hope to be equally in the future, fortunate enough to enlist the assistance of a number of specialists in other countries and in this way we have built up in the Museum a magnificent collection of authentically-named specimens, among which are a very large number of 'types'. In order to be certain of the correct identification of a specimen it has frequently been necessary to compare it with those obtained in other parts of the world and consequently collections from overseas are often of the very greatest importance and assistance to us. While, therefore, any member of the Society can be of the greatest help to us by making collections, no matter how small, in regions outside India and sending them to us for examination, we on the other hand can be of assistance to others by naming for them the collections that they have made; and we are only too willing to undertake, so far as we possibly can with our limited staff and limited available time, to work out such collections and, if desired, return them to the sender, the only stipulation that we make in such cases being that we are allowed to retain duplicates for our own collection and, where the collections contain new species, to publish the description and retain the 'type' specimens. If, on the other hand, the owner is willing to part with his collection for a financial consideration, we are always willing to offer a fair price asked for the complete collection, if small, or for individual specimens. In the case of large collections, our finances will not permit of such purchase out of our annual budget, but in the case of really valuable collections the Government of India have been in the past and doubtless in the future will be prepared to consider the question of the purchase of such for the Zoological Survey of India.

THE PUBLIC GALLERIES

By B. Prashad, D.SC., F.R.S.E., F.A.S.B., F.L.S., F.Z.S.

In the introductory chapter Col. Sewell has given a short summary of the history of the origin and development of the Zoological Survey of India, but since the Zoological Survey owes its development as a research institution to the establishment of the museum, and as one of the paramount duties of the Survey is the proper maintenance and development of the Zoological and Ethnological public galleries of the Imperial Museum, it will be useful to recapitulate here briefly the history of the development of these galleries.

In the original scheme for the foundation of the Asiatic Society of Bengal there was no mention of the establishment of a museum, but non-resident, mofussil members sent in curiosities of various kinds to the Society from time to time, and with the increase in their numbers, the Society seriously considered the question of having a suitable house for their preservation and exhibition in

1796. No practical results, however, ensued from these deliberations till the building of the Society was completed in 1808. In 1814 the first advance in this direction was made as a result of a letter from Dr. N. Wallich. Dr. Wallich, who was a Danish Botanist of great repute and was working in the Calcutta Botanical Gardens, had extensive private collections of Natural History objects etc., and he not only proposed to present to the Society duplicates from his collections but also offered his services free for looking after the Society's museum. The proposal was carefully considered and it was decided to establish in the Society's building a museum containing exhibits of all kinds from all over the East, and Dr. Wallich was appointed the first honorary Curator. During Dr. Wallich's period of Curatorship, owing to his being a Naturalist, very great attention was paid to the development of the Natural History Section of the Museum, and this continued to be the case under his successors, Pearson and McClelland, both of whom were medical men and were specially interested in the Natural History of India. Later, paid Curators were employed, but owing to the meagre salary of the post no really qualified man could be obtained till 1841. With increased grants from the Court of Directors of the East India Company in 1841 Dr. Edward Blyth was selected from London and sent to Calcutta to take charge of the office of the Curator of the Society's museum. Dr. Blyth was an exceptionally well qualified and a very enthusiastic Zoologist, and as a result of his devoted labours and the interest he was able to arouse in Natural History in the members of the Asiatic Society, the collections in this section of the museum soon outgrew the resources of the Society. Without going into details about the protracted negotiations that went on between the Board of Directors of the East India Company and later the Secretary of State for India and the Council of the Society in reference to the establishment of an Imperial Museum in Calcutta, it is enough to note that the Indian Museum was definitely established as an imperial institution and all the collections from the Asiatic Society's building were transferred to the new building of the Indian Museum in Chowringhee in 1875. In this connection it is of special interest to record that at this time the Natural History Section was considered the most important section of the Museum and had under its charge not only the show galleries containing Natural History exhibits but archaeological and other miscellaneous exhibits as well. Dr. John Anderson, a professor of Natural History from Edinburg, was now appointed the first Curator of the Museum and later the designation of his post was changed to that of Superintendent of the Museum. It will thus be seen that in the earlier years the development of the Museum was intimately bound up with that of the Natural History Section of the Museum. The various Superintendents paid special attention to collections of Natural History specimens, and these were arranged and displayed in large public galleries according to the ideas then in vogue, but as was very well expressed by the late Dr. Annandale 'the question of the utilization of the Museum collections for the purpose of display and popular education in the Indian Museum was not unfortunately developed to the same extent as the scientific utilization of these collections. Superintendents of the Indian Museum were 'faced throughout its history as a Government institution by the fact that the funds at their disposal have not been adequate both to encourage zoological research and to display to the public its results in a manner worthy of an Imperial Museum. They have deliberately chosen the alternative that seemed to them, in the peculiar circumstances prevalent in India, the better of the two, and have frankly claimed that the chief function of the zoological section must be to act as a centre of investigation. The peculiar difficulties that exist in India in respect to the public galleries of a zoological museum are both physical and educational. On the one hand we have the tropical light, and a comparatively great range of temperature; on the other, both the illiterate condition of the vast majority of the visitors and the eagerness with which students learn the statements on labels by rote. The last is a difficulty that is apparently by no means easy for a museum curator in Europe to appreciate, but is a very real one in Bengal, if not also in other countries.

At the present day there are under the Zoological Survey six zoological galleries of the Museum, two for Mammals, one for Birds, Reptiles and Batrachia, one for Fish, one for Invertebrates, one for Insects and Arachnids and one Ethnological gallery. The collections in these galleries are representative of the various classes of animals found in Asia and more particularly in India, but in order to make the survey of the Animal Kingdom complete several foreign animals are also exhibited. The public galleries, as noted above, are unfortunately not in a condition of which an Imperial Museum can be proud, but attempts are being made to remodel the galleries and replace the antiquated specimens by more up-to-date exhibits. For lack of funds the Victorian idea of exhibiting specimens in a museum gallery, which was adopted when the galleries were originally designed and arranged, has not, except in a few cases, been materially changed. The new Invertebrate gallery, however, and to a certain extent the Insect gallery, are models of what a public gallery in a museum should be, but even in these galleries nature-study groups of different classes of animals in their natural surroundings are a great desideratum. It is hoped that the deficiencies will be filled up as funds and the necessary technical help become available.

THE LIBRARY

By B. Prashad, D.SC., F.R.S.E., F.A.S.B., F.L.S., F.Z.S.

An up-to-date reference library is a very necessary adjunct to any zoological department, for, as is well known, systematic zoology is absolutely impossible without books. In Calcutta we are fortunate in having a zoological library which is probably as complete as that in any English or foreign University or Museum. The collection of books in this library, which was transferred to the Zoological Survey of India from the Natural History Section of the Indian Museum in 1916, had been got together by the unceasing efforts of the officers of the department for over fifty years, and consisted of roughly 12,000 volumes. Since that date, in normal cases, roughly 600 volumes have been added every year, while on two occasions, as a result of special grants for the purchase of books from the Government of India, a large number of older works and many of the more recent standard publications have been purchased. On a rough estimate the number of books in the library today is over 20,000 volumes.

In the earlier years owing to the lack of funds the Museum library was deficient in several of the older publications which had already become classics and were, therefore, rare and very costly, and in the complete series of several periodical publications. This was due, at least in part, to the policy followed on the institution of the Indian Museum, when for lack of sufficient funds it was decided not to re-duplicate those publications which were available in other libraries in Calcutta. Many of the costly earlier publications were, therefore, not purchased for the Museum library, and the available funds were utilised for purchasing such works as were not available in any other library in the town. It may also be mentioned that most of the rarer earlier publications mentioned above are available in Calcutta in the libraries of the Asiatic Society of Bengal or of the Geological Survey of India. From the beginning of the twentieth century however and more particularly with the appointment of the late Dr. N. Annandale as the Superintendent of the Museum in 1907 the necessity of having more complete collections in the departmental library was brought home to the Trustees of the Indian Museum and through this body to the Education Department of the Government of India. The grants for the library were thereafter materially increased and the Museum library as a result has grown at a rapid rate. Further with the starting of the two special serial publications of the Natural History Section of the Indian Museum,—*viz.* the *Records* and the *Memoirs of the Indian Museum,* which with the institution of the Zoological Survey of India became the publications of the Survey Department—it was possible to greatly extend the exchange of publications with institutions and other bodies which publish zoological periodicals. As a result, the library of the Zoological Survey of India to-day receives every year about 200 serial publications, and of these only a small number are obtained by purchase. Within recent years as a result of the special grants mentioned above, it has also been possible to fill up many *lacunæ* in the serial works and purchase several standard works of reference, which were wanting in the departmental library, and of which unfortunately no copies are available in any other library in Calcutta.

In the earlier years and even up to the foundation of the Zoological Survey of India, the library of the Natural History Section of the Indian Museum in accordance with the statutory limitations was not a lending library and none of the library books could be removed out of the Museum building. With the foundation of the Zoological Survey of India, however, the Government of India suggested the desirability of throwing open this valuable library to approved workers all over the country. Since this change of policy a very important activity of the library is the lending of books to workers all over the country and thereby enabling them to carry out research which, except in special centres, was hitherto impossible. Even though the number of workers in India is not very large at the present day still a fair number of books are sent on loan all the year round from the departmental library to workers in all parts of India. In addition requests are often received for the loan of books from Ceylon and other countries in Asia. Naturally these requests cannot be complied with, but as far as possible typed copies of the necessary references with photographs of plates are supplied.

The library of the Zoological Survey of India is particularly rich in certain sections especially Crustacea, Fishes, Molluscs, several groups of Invertebrates, various classes of Insects, etc., in which groups workers have carried out researches in the Museum and in the Zoological Survey. In these cases all the necessary literature has been accumulated and kept up-to-date, while in other groups like Mammals and Birds, there are unfortunate gaps and the library in these sections is not so well supplied as it should be. Attempts are, however, made from time to time and as funds become available to procure the missing publications and other works of general importance.

The library also contains a very rich collection of the reports of the different scientific expeditions all over the world and has a good collection of anthropological literature.

Unfortunately there is no up-to-date printed catalogue of the books in the library, but a list of the serials available will be found in Dr. S. W. Kemp's 'Catalogue of the Scientific Periodicals in Calcutta Libraries' published by the Asiatic Society of Bengal. The library is open to students and those interested in Zoology during office hours.

(*To be continued*)

A BUTTERFLY HUNTER'S RAMBLE IN THE TAVOY DISTRICT (BURMA)

BY

W. S. WOOD

The Tavoy District (stretching from Ataran on the north to the Mergui border on the south, and with Siam as its eastern frontier, contains many types of country from the open paddy-lands of the Tavoy river-valley, through the deciduous forests and bamboo jungle to the vast evergreen forests that densely clothe the hill slopes. It offers an unsurpassed field for the butterfly collector.

On a bright morning in the month of October an equally enthusiastic fellow collector and myself have decided on a whole day's outing. We make an early start from Tavoy Town by motor-car and, a fair road permitting, reach the Hermyingyi Inspection Bungalow by 8 a.m., and as we propose to walk over the watershed lying between the Kamounghla and Pauktaing streams, send the car back to meet us at the Wagon Bungalow, on the other side of the divide.

As we leave the car and cross a flat we 'flush' a swarm of Crow-butterflies (*Euplœa*) breakfasting off the flowers of a small shrub and soon our nets are busy. There are so many and in such variety, that it is difficult to select individuals from the bevy who with their peculiar slow and jerky flight circle round us. By far the most numerous is *mulciber,* in lesser numbers we observe *diocletiana, harrisi, klugii, limborgi, godarti,* and there is one *bremeri,* who, directly he is spotted in the crowd appears to become aware of our felonious intentions and, leaving his fellows, makes a bee-line over the shingle on the margin of the stream, and we after him. His jerky flight, though perhaps deceptive, does not make for speed, and just as he reaches the stream—across which lies safety—my net engulfs him and he is duly added to those of his fellow feasters. I look back to see my companion blandly contemplating nature from a sitting posture having in his rapid progress stepped on a round stone and gracefully subsided earthwards. I come and help him to rise and display to him *bremeri* now safely housed in his paper envelope.

A peculiar feature of these congregations of *Euploeas* is that they are entirely composed of males; the ladies of the genus apparently do not grace the feast with their presence, or perhaps it is only the convivial bachelor parties that we stumble across.

Our way lies along a bridle-path which serves the tin-mines. We proceed on our way, picking up a few of the early-flying Hesperids, and reach a small brook on the margin of which grows a species of Calladium; a small drab-coloured butterfly rises at our approach and we give it a passing glance. Probably it is only a Common Bushbrown (*Mycalesis perseus*) of which we have seen many, but no *perseus* ever had those rufous coloured fasciae crossing its wings on the underside and this is something new to us. Warily we stalk it with nets outstretched. Just as my companion is within striking distance, another butterfly of the same kind flies past and away goes our quarry in chase of him and both of them enter an impenetrable brake of thorny canes further up the slope of the hill. Sadly we gaze after the vanished prize and proceed to regain the path, when to our great joy, having chased his rival away, the small butterfly rapidly returns and my companion with a hasty sweep of the net secures him. An examination assures us that it is a *Mycalesis,* as evidenced by the swollen base of vein twelve on the forewing, and a male judging from the secondary sex-mark on the hind wing, but of a species unknown to us. We afterwards had it identified as the Malayan Bushbrown (*Mycalesis fuscum*). We linger in the spot hoping the rival will return : and return he does, settling on the identical Calladium leaf formerly occupied by the first bully. He also is safely added to the collecting case and a wait of a few minutes secures us two more specimens, all males. I daresay most butterfly hunters have noticed how individual males of certain species of butterflies appear to consider a particular patch of ground their own special domain and insistently chase away any rival male who ventures within their territory. I have never been able definitely to ascertain whether it is actual fear of the 'top-dog' that drives the rival away or whether the chase that invariably ensues is merely a mock combat more in the nature of a friendly game.

The sun is getting up above the forest trees. A howl, as of a lost soul in torment, from the hill-top above, tells us that a Gibbon has decided to hold a long-distance conversation with one of his kind across the valley, and soon the crescendo wails of this raucous duologue are in full swing. My companion dubs them 'the stomach-ache monkeys'. There is reason for the appellation, the imagination can easily grasp the idea that such doleful howls could only emanate from one tormented by the pains of a particularly virulent colic. Gibbons hold these long-distance conversations. Each individual in turn emits a string of successive howls, crescendo for three-quarters of its duration then falling away to diminuendo. To the casual listener every such oration of howls appears identical with its forerunners but close attention proves that the intonation always varies in a very slight degree and it may be that the trained ape-ear can interpret these slight intonations into words bearing a definite meaning. Thus, what to us appears nothing more than a particularly horrid noise may possibly be a very important political debate in the ape world.

We proceed on our way; the path, following the line of least resistance, runs along the base of a valley and parallel with a stream; in the bed of which many moist sandy patches occur beloved by certain species of butterflies who on a hot day appear to have acquired that East-of-Suez thirst immortalised by Kipling. Over one of these patches of sand we see a butterfly hovering, which from a casual glance, appears to be nothing more than an extra large male *Euplœa mulciber;* but it is not quite a *Euplœa* in its manner of flight and we are not satisfied and decide to investigate closer. The butterfly has by now settled on the patch of sand but rises at our approach and a closer view shows us that it is indeed a prize worthy of capture, being no other than a male of that rarity *Chilasa paradoxa telearchus,* the Great Blue Mime which mimics *Euplœa mulciber* so closely as to deceive any insect-eating bird looking for a tasty morsel. *Telearchus* evidently does not trust us and flies away up-stream, but that juicy patch of sand contains temptations not to be resisted, and he soon returns, when a quick sweep of the net, from behind him, for ever puts him out of the reach of all temptations. What a beauty he is! with his long tapering and iridescent purple forewing. As we safely esconce him in the collecting case a large white butterfly flies rapidly by us upstream; my companion remarks that to him it looked like a Great Orange Tip (*Hebomoia glaucippe*) but lacking the apical orange patch to the forewing. As we are discussing the possibility of this, back comes the subject of discussion and swiftly circling us flutters down on the same succulent sandy patch which proved the undoing of *telearchus.* He moves in short jerks over the sand and his hind-wings alternately rasp one another—no *Hebomoia* this but a particularly fine Jewelled Nawab (*Eribœa delphis*). My companion craftily stalks him and when within striking distance imperceptibly moves his net close to the ground nearer and nearer—but no—*delphis* is not too busily engaged not to note the creeping net and, just as hopes of a successful 'dab' run high, the patch of sand knows him no more and there he is high above sitting on a leaf and head downwards, contemplating us, and those rasping hind-wings seem to tell of his sardonic joy at our discomfiture. We tentatively reach up a net towards him only to find that it is at least five feet too short and those rasping hind-wings move faster as if to emphasise his 'gloat' at our further discomfiture. This is intolerable. While my companion stays to watch him, I go off in search of a stick to tie to the net-handle. I find one and by the tying it to the net-pole with our handkerchiefs we construct an instrument for the outwitting of *delphis* sitting there enjoying his 'gloat'. True the splice is not very firm, but with careful manipulation the improvisation might serve and slowly and with bated breath the net is raised closer and there sits our Nawab, all unwitting of the destiny approaching him. Now is the time to strike! I take a firmer grip of the stick and slowly back-swing for the stroke—and the improvised splice collapses! ! There goes *delphis* to a higher leaf. He is well out of reach of any improvisation now and those mocking hind-wings of his rasp faster as head downward he surveys us from his new perch of safety. We look around for missiles wherewith to make him move and find them in the small pebbles of the stream bed. For the next five minutes we are engaged in bowling 'full-tosses', 'donkey-drops' and 'googlies' at him. *Delphis* enjoys it all but never moves and we are just considering the advisability of hurling larger stones with some force at him, when he suddenly drops, rapidly circles us, and is away up-stream before we can realize that he has gone. Will he return? We bear in mind the succulence of that sandy patch and decide to wait, trying to immobilize ourselves into the semblance of stone monuments. Yes, there he comes, and we freeze harder; my companion craftily takes cover by sitting down within reach of that sandy patch. My suggestion that I should further camouflage him by heaping sand over him is somewhat coldly received. *Eulepis,* by this time, has paid another visit up-stream and is back again and flutters round us, even investigating for a brief moment my companion's nose, but immobile we wait; not till he settles down again on his patch of sand can he be undone and presently from his perch on my companion's hat he hops down. Probably he has decided that we are harmless stones after all, and soon is engrossed in sucking moisture, or whatever it is he gets, from the sand. A quick clap of the net-mouth on the ground and he is inside, his quick eye has seen a small aperture where the cane of the net rests on a small pebble, and already he is half out of the aperture. I hurl myself flat and just in time close the aperture with my hat, madly he flutters in the net, eluding our efforts to 'nip' him and suddenly the net appears empty, there is certainly no struggling insect there. Has he after all discovered some means of escape and vanished into thin air? We peer through the net. Ha! there he is the cunning rascal, sitting immobile on the sand within the net-mouth in the hope that we will raise the net incautiously to peer inside when away he will go like a streak of light. Further manipulation adds him safely to the collecting case, and the satisfaction of successfully 'bagging' him is supreme. We linger by the sand patch for a short while but nothing of further interest visits it and we regain the path and proceed.

The bridle-path now assumes a steeper gradient and is flanked, on its lower side, by some of the giant forest trees. On the mast-like bole of one of these, a man's height from the ground, a brilliant verditer-green snake, about six feet in length and of the thickness of a one inch hose, is observed. His shining scales glisten in the sun as sinuously he glides up the bole of the tree. 'A particularly fine specimen of a harmless tree-snake' I observe, and playfully poke him gently with the butt-end of the net pole; he is around in a flash, and assumes a fighting attitude striking viciously at the still-extended net pole. Not being snake men we hastily retire with an abject apology for the intrusion and wishing him good-luck and good hunting, proceed.

With such meetings who can say that that spice of all sport—the element of danger—is absent in butterfly hunting?

By the way why is it that most popular pictorial representations of snakes on trees invariably show the reptile wound round the trunk or branch of the tree in the form of a spiral spring? I have seen many different species of snakes ascending trees and I do not recollect once having observed this spiral mode of ascension. On the contrary the reptile appears to climb by getting a grip on the bark of the tree with the scales on its belly, or it glides from bough to bough (if these are within reach) bridging even a wide gap with its body. I have even observed a tree-snake to rest easily on a single thin bough and at right angles to it, with only a kink of its body slightly depressed to maintain equilibrium; in a case like this one would imagine that a spiral or two would be advantageous for security of hold, but the reptile made no attempt at a hold in this manner and moved off along the limb in the ordinary way one sees a snake progress on the ground. In the Coffee plantations in Southern India, I have observed the pit-viper perched on a Coffee-bush with a spiral or two of his tail around a branch but never in the manner of the full-spiral as popularly depicted in pictures illustrating the story of the Garden of Eden and the downfall of Mother Eve.

We saunter up the bridle-path and are presently passed by a Chinaman—a tin-miner probably; seeing the net in our hands he stops to watch us. I slyly suggest to my companion, who has just taken a specimen of an undoubtedly extra nauseous-tasting White Tiger (*Danais melanippus*), that for John's benefit he extract the fly and pretend to eat it, and he being somewhat of a sleight-of-hand *artiste* the idea is successfully conveyed. A wonderment slowly dawns on the Celestial's somewhat flat features, and seeing the success of the experiment, I grab another passing *Danais* and with every manifestation of the enjoyment of a tasty tit-bit pretend to swallow it. John is convinced. To him there is nothing *outré* in the idea, for is the diet not in keeping with the 'slugs and snails and puppy dog's tails' which find a place on his menu card? And with the radiance of a new discovery illumining his features he trudges off and turns a corner. I suggest to my companion that around that corner I would not mind betting we should find John Chinaman trying to catch butterflies for a meal, and on turning the corner sure enough there he is industriously endeavouring to catch with his hat some wildly whirling *Danais* and *Euploeas*; he somewhat sheepishly desists when he sees us and moves off towards the mine, but I dare say that Chinaman, at some future date, tried out the diet; let us hope that his first experimental efforts did not have as a victim some member of the nauseous-tasting protected group. Who knows, perhaps that very quality may have commended itself to a Chinaman's palate!

Proceeding we soon reach the mining-camp composed of a collection of huts and wooden barracks and housing a medley of nationalities—Ooriyas from Orissa, Chinamen from Yunnan and from Canton and Peking, a sprinkling of Tamils from Cocanada way, Ghurkhas from Nepal, Sonthals and even burly Pathans from the North-West Frontier Provinces of India, Burmese, Talaings, all attracted by the lure of easy-money and perhaps what to them is a fortune to be made from tribute-work on the tin-mines. Facing the camp Nature is a wreck. The contrast is appalling. Evergreen forest side by side with a desert where the bones of Nature lie strewn over a veritable Golgotha, these mark the site of the tin-workings. We shudder and hurry on and out into the forest again, and presently come to a point where the path crosses a stream. Here, perhaps for some projected tin-working, the large forest has been cleared and a secondary shrubby growth has sprung up. The rays of the sun are just pleasantly warming this glade.

It forms a rendezvous for many species of butterflies. The first of these to attract our attention are some small brilliantly blue and green *Lycænidæ* and we soon gather in a few specimens. They prove to be mostly the gaudy-coloured males of the Common Gem (*Poritia hewitsoni*) and in lesser numbers the Green Gem (*Poritia picurata*) and Narrow-banded Brilliants (*Simiskina pediada*); handsome little fellows they all are with their brilliantly coloured blue and green wings. Here also comes that John Gilpin of the butterfly world the White Dragontail (*Leptocircus currius*)—apt name—and his cousin the Green Dragontail (*Leptocircus meges*), with their quaintly pointed and ridiculously extended hind wings fluttering behind like coat-tails flying in the breeze. We gather in a few of these as also a variety of *Euthalias* who have arrived to warm themselves in this sunny glade before setting out in search of food, or the courting of some fair lady butterfly. A large, apparently drab-coloured, erratic-flying, butterfly comes through the glade, now up at the tip top of a tree, the next second down at its base, a swift turn to the right, and as I move in that direction to intercept it, as swift a turn in the opposite direction out of reach. Then, just as we think it is going away it arrests its flight with the suddenness of a thunder-clap and sinks on a leaf with wings outstretched, we catch a gleam of brilliant peacock green and breathe in unison '*Papilio palinurus*' that most elusive and beautiful of the Tenasserim Papilios—the Burmese Banded Peacock. A careful stalk, a gradual approach of the net and a swift upward catch and we have him, but alas! one of his delicate spatulate-shaped tails suffers somewhat and hangs limply down. Nevertheless this can be mended, and he is far too valuable a prize to forego, so we carefully enclose him in his paper envelope and consign him to the collecting case with a sense of satisfaction.

The glade promises good sport and we decide to stop awhile. A sudden exclamation from my companion makes me turn towards him and I see him vainly attempting to catch a butterfly which appears to be bent on investigating his face at close quarters. Its rapid flight in small circles round him makes it impossible for him to catch it with his long-handled net, and I go to his rescue, but my effort at a catch only results in knocking off his pince-nez and as we search for these in the long weeds the butterfly is away and across the glade. We recognize the would-be investigator as the Banded Swallowtail (*Papilio demolion*) one of the most erratic-flying of that large family. *Demolion* comes to rest on some red flowers growing on a tree across the glade surrounded by a belt of some creeping plant. I sprint across the glade and into the belt of creepers, with painful results. A large colony of red-ants have decided on these creepers as a favourable autumn residence and turn out *en masse* to repel the invader. The whole world seems full of red ants, and as I frantically endeavour to brush off the angry insects more and more of them come up to the attack and a strategic retreat is clearly indicated; once free of the entanglement of the creepers it is possible to brush off the insects, but stray ones, overlooked, make their presence unexpectedly and painfully felt for some time afterwards. My companion's laughter at the antics engendered by my efforts to get rid of the ants did not tend to make the experience any less painful. I am of opinion that *demolion* was perfectly aware of these ants and with diabolical intent lured me into the trap. The Burmese name for these red ants is 'Kha-gyin' literally meaning bitter-acid, and a paste made from pounded ants and their eggs sometimes finds a place in the Burmese menu. In some localities this is considered a great luxury. I have heard it stated by Burmans, with what truth I cannot say, that these ants are sometimes utilised by Burmese hunters, or 'Moksohs', as a means of 'cooking' flesh when the necessary articles to cook with are absent. The method followed is to find a red ants' nest, to break this open and place small pieces of the flesh inside, the ants attack the meat and by the injection of the acid resulting from their bites the meat becomes similar to cooked meat and edible. Probably this is a little wide of the mark and possibly the only effect of the injection of acid tends to preserve the flesh and enable it to keep longer than it otherwise would have done.

Demolion by this time has gone but, knowing his habits of flying on a regular beat, we decide to wait; he returns and flutters round the identical bunch of flowers with its red ant guard. I suggest to my companion that he has a good chance of taking *demolion* here but remembering the ants he withers me with a look. We watch him and presently, with his peculiar up and down fight, he makes straight for us, this time, however, a net engulfs him and he is consigned to the collecting case.

Our attention is suddenly arrested by the appearance of a large butterfly sailing majestically high overhead—to all appearances it looks like a very large specimen of *Euplœa diocletiana*-- With a slowly circling motion the butterfly suddenly sails down towards the stream on the edge of the glade and disappears from sight behind the bushes fringing the bank. We proceed to investigate and find he has settled on a pebbly bank and, with wings folded and upraised, is now greedily sucking up the moisture; closer investigation shows us that this is no *Euplœa diocletiana,* but a male of that beautiful rarity *Chilasa paradoxa,* var. *danisepa;* a wary stalk ends successfully and we are soon admiring his tapered white-patched and iridescently blue wings. The female of this species appears to be very rare in the Tavoy District. In the course of sixteen years of collecting, I have succeeded in securing only one specimen, and that a damaged one. Males are fairly plentiful in favourable localities, chiefly in the month of October, but I have observed stray specimens of this butterfly right through the hot weather till the break of the Monsoon. The closely allied race the Great Blue Mime (*Chilasa paradoxa telearchus*) on the contrary, appears in fairly large numbers also in October but apparently disappears entirely from December onwards and my record contains no entry of a specimen taken later than the commencement of December. It would be interesting to know whether this holds good in other localities, such as Assam, where these two species occur together.

The bridle-path leads steadily upward now, along the side of a steep hill-side where palms, canes and tree-ferns abound. In such places the *Lycænidæ* delight and we are able to add a vast number of these magnificent little butterflies to our collecting case. Of the sub-family *Arhopalinæ* a large number of species have been recorded from the Tavoy District, and here in this shady patch of forest we took a number of that superb species the Lilac Oak-blue (*Amblypodia camdeo varro*) and also the White-spotted Oak-blue (*Amblypodia albopunctata*) and *subfasciata*. The patches of light, formed by the sun-rays filtering through the dense foliage, make a favourite resting place for that dainty Lycænid the White Imperial (*Neomyrina hiemalis*). This small butterfly ordinarily rests on the underside of a leaf and we found that to catch it successfully one required to strike with the net from above the leaf forming its shelter. It is so quick in its action of getting away, if struck at from below, that the effort usually ends in no catch. When warming itself in the sun, however, the butterfly invariably chooses the upper side of a leaf, sitting with wings fully expanded and showing all its beauty of pure white background, touched with metallic blue at the apices of the forewings, and its blue tinted body. Reversing the process of catching it when at rest on the underside of a leaf we strike at it upwards and are able to take a number of both males and females. Flying low in amongst the thorniest canes we observe a butterfly undoubtedly of the *Papilionidæ* but of unfamiliar aspect; it is an impossibility to get anywhere near it in its present position, and it appears to be quite content to flutter around inside the brake. We however decide to wait and presently our patience is rewarded and the butterfly emerges on to the bridle-path to fall an easy victim to my companion's net. An examination soon shows us that it is something new to us, we know no Papilio with a bright yellow body, a crimson spot in the centre of each hindwing and a narrow-necked spatulate tail. We afterwards were able to identify it as *Byasa neptunus*, the Yellow-bodied Clubtail. Here also we are able to collect quite a large number of Banded Yomen (*Cirrochroa orissa*). This butterfly is seldom seen in open country and unlike the other members of the genus *Cirrochroa* it does not appear to frequent patches of moisture along stream-beds, even where such streams meander through evergreen forest stretches. Instead the butterfly appears to delight in heavy forest, keeping particularly to the tops of the ridges. It is a strange fact that Lieut.-Col. C. T. Bingham in his *Fauna of British India*—Butterflies, Vol. I, omits all record of this butterfly; it is a strikingly marked species and, except that it superficially resembles the Rustic (*Cupha erymanthis*), should not escape the notice of a keen observer. Can it be that this butterfly has only just recently become established in the Tavoy District? This is possible, as from my observations on the local distribution of the Orange Emigrant (*Catopsilia scylla*) in the Tavoy District I have observed that within the space of the last sixteen years this butterfly has steadily enlarged its area of distribution. The *Fauna of British India* records the habitat for *Catopsilia scylla* as 'within our limits the extreme south of Tennasserim'; this record is apparently up to date of publication of Vol. II. i.e., 1907. In the year 1912 I found that

C. scylla could not be taken much further north than Pyinbyugyi in the Tavoy District, since then the butterfly appears to have slowly but steadily increased its range northwards, till, in the present year, it may be observed in fairly strong numbers as far north in the district as Kaleinaung, and it is quite probable that in the course of a very few years' time its occurrence may be recorded from as far north as Yè and even Moulmein. Perhaps it is the activities of the Public Works Department which are accountable for the spread of this butterfly in the Tavoy District, for it is most commonly found frequenting the flowers of the small roadside weeds which also steadily follow in the wake of the road-maker.

The bridle-path now runs along the ridge of the hill and the going is easier. As we go we flush a bevy of both the males and females of Archdukes (*Adolias dirtea*), who, along with the common Fauns (*Faunis arcesilaus*), and a single Great Marquis (*Euthalia dunya*) have been feeding off the juices of the fallen fruit of a jungle tree. As *dunya* is by far the most desirable of the crowd after him we go and as he rests with outspread wings on a near-by bush the successful 'bag' of him appears to be but a matter of time. It proves to be a matter of time, and a very long time. Of all the wary butterflies who seem to be able to read the stalker's thoughts and gauge his intentions *dunya* heads the list easily. He appears to know the range of any net perfectly and just as perfectly times his departure. When everything is set to make a catch, you think you have him, but you are just that one-fifth of a second too late. *Dunya* has timed that to a nicety, and departed in the nick of time to another bush, not too far away but just sufficiently near to tempt you to prolong the chase. He seems to delight in the game of discomfiture of the would-be catcher and as we know by experience can go on playing it by the hour. We creep through thorny cane-brakes, where long streamers of hook-like thorns seem to seek out the tenderest portions of our anatomy to hold us back by; half a dozen times we think we have him but all with no success till suddenly we receive support from an unexpected quarter. As *dunya* flies from us a Racket-tailed Drongo suddenly makes a swoop at an insect near where he flies. The snap of the Drongo's beak is too much for the Marquis, he loops the loop, loses his head, and flies headlong in our direction where, as he passes, a swift sweep of the net has him.

The path now crosses the Hteinthit Choung which at this season of the year is but a pleasant babbling brook. In the monsoon it becomes a raging giant as is evidenced, by the number and size of the 'pot-holes' its waters have excavated in its bed of solid granite. In the bed of this stream we are lucky enough to snap up a fine specimen of the largest *Pantoporia,* namely the Great Sergeant (*Pantoporia larymna*). A stiff climb now leads up to a height of 1,500 feet above sea-level on the western solpe of Kala Taung where utilising a disused mine road we commence the descent to Wagon on the other side of the watershed. On the way down we pass a clearing which marks the site of a miners' former camp and here we observe a number of Papilios flying backwards and forwards high over the clearing. They make an occasional downward swoop at some low passing butterfly. Taking advantage of this proclivity we are able to lure them down within net reach by throwing up small pieces of moss and twigs as the butterflies pass high overhead. At these they swoop in their descent and so enable us to secure a number of that beautiful species the Burmese Batwing (*Byasa zaleucus*) and obtain in a short while a remarkable series of the males of this butterfly with markings ranging between specimens where the white area on the hind-wing is restricted to a single white spot, to others, at the other end of the series, where the white area on the hind-wing is large and conspicuous.

We descend, and on reaching the flats lying alongside the Thabyu Chaung our attention is attracted to a congregation of large birds of falcon-like appearance slowly circling round a near-by tree. At first sight we are unable to account for the presence in such large numbers of the birds but a movement in the tree itself shows more of the birds vigorously attacking a hive of the large wild-bee. The hive, a large one about six feet long, hangs from the underside of a thick bough and the birds' method of attack is to cling to the comb with their claws and with continuously flapping wings to tear open the comb with their beaks; no doubt to feast off the honey within. We noticed that the birds so employed apparently were not unduly incommoded by the defence of the angry bees. Individuals were observed to cling to the hive for quite a prolonged time, though in some instances we did observe a bird leave the hive rather hurriedly and as it flew away to ruffle its feathers and give its body a vigorous shake as if to dislodge bees which perhaps had found an entry between the feathers. Even when large portions of the honey-comb became detached and fell to the ground some of the birds followed these down and proceeded to feast off the honey contained.

We much regretted the absence of a gun, if only to even things up on the side of the bees, and also to obtain a skin or two for identification. The birds were so numerous and their attack so vigorous that in the short space of half an hour or so there was no vestige of a hive left. Not having sufficient knowledge of ornithology we were unable to say whether the birds were Honey-buzzards.

We proceed on our way and soon after reach the Dak Bungalow at Wagon where we find that the motor car and tiffin await us. This despatched we do not tarry long here for on our way back to Tavoy we propose to visit a small isolated peak near Pagaye village. On the summit of this peak, we know from past experience, certain rare species can usually be caught late in the afternoon. The car soon swings us back along the road towards Tavoy and leaving the car in Pagaye village we climb the peak. Its rounded summit is ringed by trees. With bamboo jungle lying on the west slope of the hill and evergreen forest covering the eastern slope, it forms a favourite rendezvous for all manner of butterflies who seem to take advantage of the declining sun's rays for a final warming up before seeking shelter for the night. To-day we are in luck, for as we reach the summit, we are able to collect a number of rare Spotted Flashes (*Rapala subguttata*), and a short wait enables us to gather in some specimens of those uncommon Hesperids the Flats, *Odina decoratus* and *Odina hieroglyphica ortygia;* here also for a final warming up comes the Elegant Emperor (*Eulaceura osteria*) and we gleefully gather in some four or five male specimens of this Tennasserim butterfly. In the Tavoy District this butterfly is decidedly uncommon and in many years' collecting I have rarely met it elsewhere than on this small peak near Pagaye village. Lycænids of all species visit this peak and the Green Oakblue, (*Amblypodia eumolphus*) flashes his green iridiscence from every leaf which affords a point of vantage for getting the sun's rays, and here and there a ruby-coloured flash proclaims the presence of the males of a Cardinal (*Thamala marciana miniata*) while round the ring of trees the Common Clubtail (*Byasa coon doubledayi*) glides aloft. Of the lesser fry quite a number fall to our nets and, well satisfied with the sense of a day well spent among beautiful surroundings, we retrace our steps and, joining the car, are speedily whirled into Tavoy Town, and the subsequent examination of the day's catch forms not the least interesting portion of the day's experiences.

In the foregoing I have tried to describe—very inadequately I fear—only one of many pleasant rambles in the Tavoy District where the main object has been the collecting of butterflies, but during which the observation of the doings of birds, beasts, reptiles and insects generally, has proved of just as much interest to the writer.

THE PRESENT STATE OF THE GAME AND WILD LIFE IN CEYLON

BY

W. W. A. PHILLIPS, F.Z.S.

(*With five plates by G. M.* CRABBE)

The last decade has seen a great change in the state of the Game and general Wild Life of Ceylon. Since the days preceding the War the conditions governing the survival of much of our Fauna have altered materially—an alteration, in most cases, greatly to the detriment of our larger species.

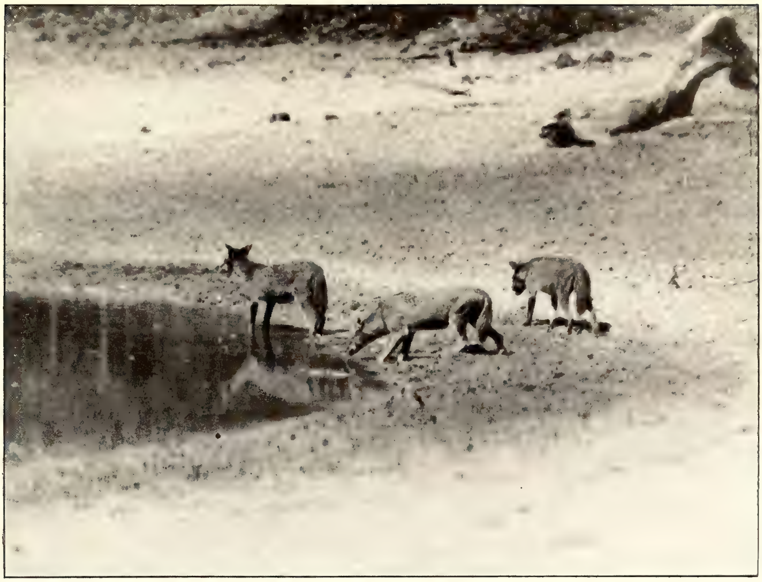
The days of peace and the gradual return of prosperity brought to Ceylon a great influx of cheap guns, together with motor cars and motor buses, and it is chiefly to these agencies that we may trace the rapid diminution of the larger forms of our once abundant wild life.

In the days when transport was by the old slow bullock cart, and the comparatively few guns were in the hands of responsible persons, the low country jungles, of the greater part of the Island, teemed with Game and Wild Life of all descriptions. Both in the sanctuaries and reserves, and out of them, deer were plentiful and the other larger members of our fauna were as numerous in the jungle districts as one could wish; the roads through these jungles were full of interest to the sportsman, the naturalist and the traveller alike. Game laws existed and were enforced as much as was necessary.

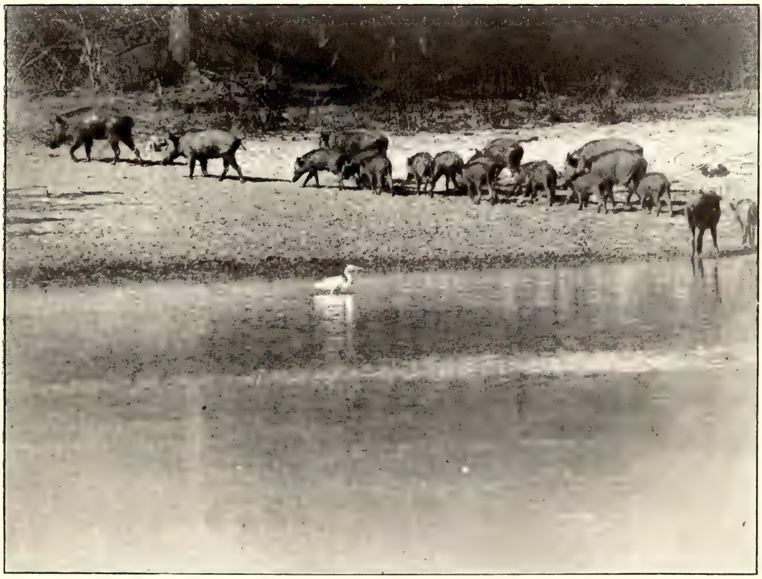
Nowadays, however, with good roads, quick transport and guns in the hands of almost everyone, coupled with the lax enforcement of the game laws, much of the country is almost completely denuded of the larger forms of wild life and the jungle roads have lost, in great part, their chief interest.

In the unreserved jungles of many districts deplorable conditions prevail; these jungles, which would in the natural course of events teem with deer, have been so plundered by that arch-enemy of game and game protectors, the meat and hide poacher, that few now remain of the once large and numerous herds of deer. Almost all have been shot down, during the dry and rainless months—the close season when no sportsmen are about.

The modus operandi of the dried meat scoundrels is to treck away, during the dry season, into the more remote jungles—in many cases accompanied by carts to carry their impedimenta and to bring out the dried flesh—to erect 'machans' or platforms over the remaining waterholes, to slaughter the deer both by day and by night as they come to drink, to cut the flesh into strips, to dry it, or smoke it, on low grids over slow fires and to bring the dried flesh out for



Ceylon Jackals (*Canis lanka*) drinking at a water-hole.



A Sounder of Pig and a Great White Egret.

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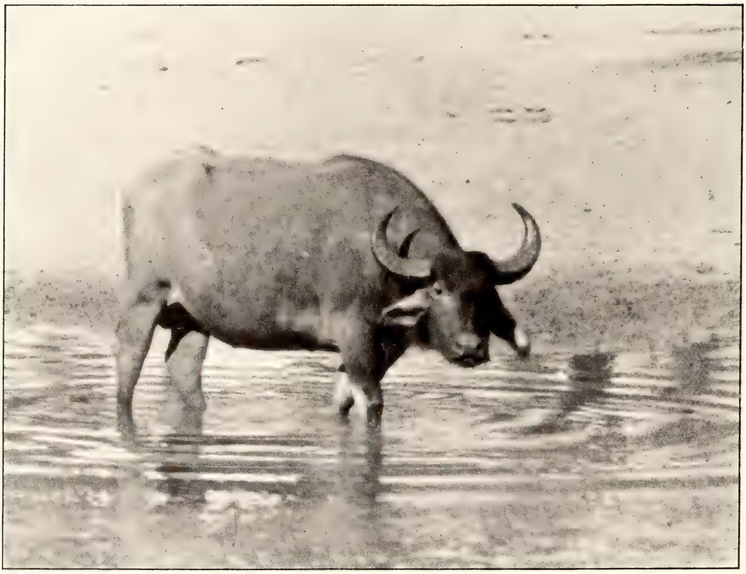
Wild Buffaloes in the Menik Ganga



Wild Buffalo (*Bubalis bubalis bubalis*) at a water-hole.

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sale in the towns and villages. The 'trade' is chiefly in the hands of the Moormen or Coast Moors; they are responsible for the greatest slaughter that has taken place among our Game.

Again, owing to the activities of some of our comparatively recently opened tanneries, the skins of many smaller animals and some reptiles have become marketable and therefore sought after by the village shikari and the Moorman trader. Again the jungles have been invaded and much of the fauna shot down or disturbed and driven to the more remote forests. It is pleasing to note however that of late this trade in smaller skins has died down to some extent; there is now not nearly the demand that there was a year or so ago.

The fauna of Ceylon is distinctly limited as to the species of large mammals found within the jungles of the Island; we may therefore be permitted to glance at each of the larger species individually, in order to gain a more exact idea of the present state of each.

Elephants.—The Ceylon Elephant (*Elephas maximus zeylanicus*) is probably as numerous today—if not more so—than fifty years ago. This is entirely due to the strict preservation which followed on the senseless slaughter of the middle of last century. To my mind the elephant in Ceylon is, today, too numerous in the populated districts and in the jungles adjoining. Much as I like to see the lordly elephant in his native forests I fully sympathise with the villager who has his paddy fields or his 'chenas' raided nightly and who often moves through the jungle surrounding his village in fear of his life. It is the elephant that is responsible for more than three-quarters of the damage done to crops and property by 'Game' in Ceylon and, except in isolated cases, it is he and poisonous snakes that are solely responsible among animals for the loss of human life. True, nowadays, all 'rogues' are proclaimed as soon as they become a menace to life or property and 'kraals' are held for the capture of elephants for purposes of domestication but, even so, much damage is done before they can be shot or captured. Such large animals are not, and cannot be, compatible with an increasing and spreading population; they must give way and be confined to certain areas, such as the game reserves and sanctuaries, where their herds can be controlled to some extent; in the low country jungles surrounding villages and cultivations, where they are still numerous today, they are a menace and a nuisance.

Buffaloes.—The wild Buffalo (*Bubalus bubalis bubalis*) in Ceylon is most probably the descendant of imported tame buffaloes that have escaped, many generations ago, to the remoter jungles and have established themselves there. It is distinguished from its domesticated cousins only by its rather larger size, generally darker colour and its more massive horns.

Nowadays the wild buffalo is only found in the remotest jungles, in the reserves and in the sanctuaries. Some years ago its numbers were so decimated by rinderpest that its extinction, as a wild animal in Ceylon, was feared. A wise prohibition of all shooting however saved the species and it is once more firmly established in its habitats. In fact, in one or two places it has increased to the detriment of other species of game and it is becoming a problem as to how it should be dealt with in the Yala Sanctuary and Palatupana Reserve, its chief strongholds today.

It is very little poached, is difficult to capture and as the license fee is fairly heavy, is not much shot by sportsmen; it has few natural enemies other than disease and it is therefore as numerous as conditions warrant.

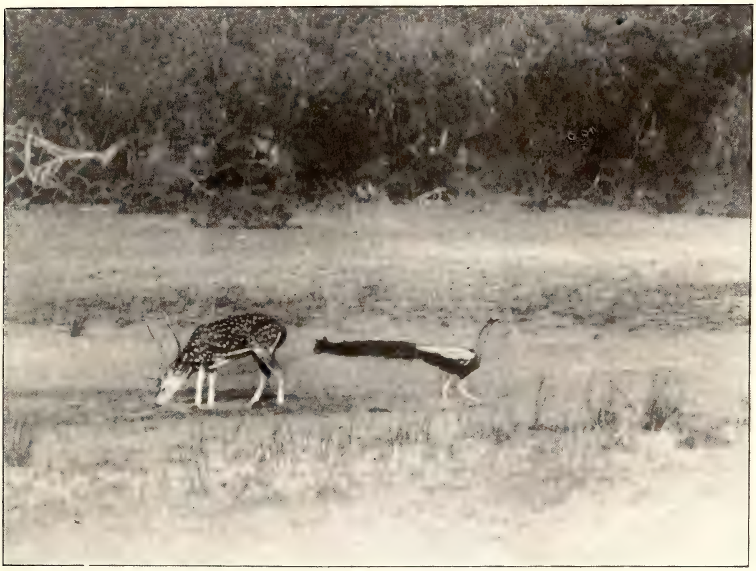
Sambhur.—Although the Ceylon Sambhur (*Rusa unicolor unicolor*) is reputed to be of the same race as that of the Indian mainland, it seems to be rather smaller in body and carries distinctly inferior antlers. It is found all over the Island from the slopes of the highest mountains to the seashore. It is nowhere very numerous and would most probably soon be wiped out were it not for the protection that it receives. In the hills over 4,000 ft., it is strictly preserved, for hunting with hounds and the knife. Three Hunts divide the available country between them and, together with the Ceylon Game Protection Society, provide watchers to prevent poaching and to keep down the Sambhur's natural enemy, the Leopard.

In the Low Country it is well preserved in the game sanctuaries and sportsmen's reserves, where it is still moderately numerous, but outside these reserved jungles, which are watched by Government and Game Protection Society's Game Watchers, it is not at all plentiful now-a-days. It is, unfortunately, an animal that is particularly easily poached over waterholes and, as it is much sought after by the poacher, on account of both its hide and its flesh, it has for this reason become scarce in many jungle tracts.

Ceylon Spotted Deer.—The Ceylon Spotted Deer (*Axis axis ceylonensis*) the Island representative of the Indian Chital, is very much the most numerous of all the deer in Ceylon. It is confined to the drier zones of the Low Country where it is found in herds, large and small. This deer, being the most numerous, has suffered, more than any, from the lax enforcement of the game laws. Until comparatively recently it was very plentiful in suitable open jungle and scrub in most part of the Low Country; there were few places, with the exception of the dense forests, where it was not found in reasonable numbers. Today however there are many ideal tracts, especially towards the north, where there is scarcely a deer left; there are few enough in the jungles surrounding the populated districts but in the remoter areas, where few officials or sportsmen penetrate and the poacher can carry on his slaughter unchecked throughout the dry season, the Spotted Deer has almost ceased to exist. It is a relief to return to the all too small reserved tracts where, thanks to the watching done by the game watchers provided by Government and the Game Protection Society, the numbers of this deer have not diminished.

Hog Deer.—The Hog Deer (*Hyelaphus porcinus porcinus*) is probably a comparatively recent addition to the fauna of Ceylon. There is a tradition that the species was first introduced during the occupation of the Dutch and it would seem most probable that this tradition is founded upon fact. The deer is only found within a narrow belt of country, running parallel to the coast, in the wet and steamy tract of low country lying chiefly within the western and southern provinces.

Wild Buffalo and Ceylon Spotted Deer on the Menik Ganga.



Ceylon Spotted Deer (*Axis axis ceylonensis*) and Peacock
at a jungle Water-hole.

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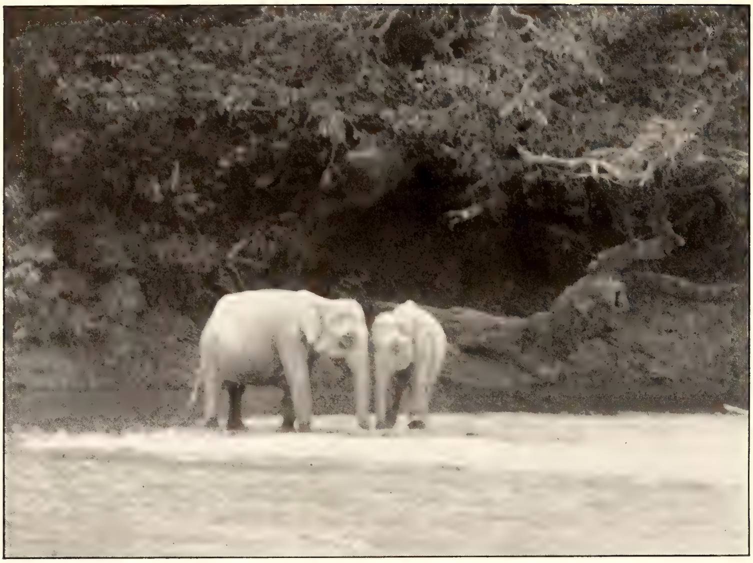
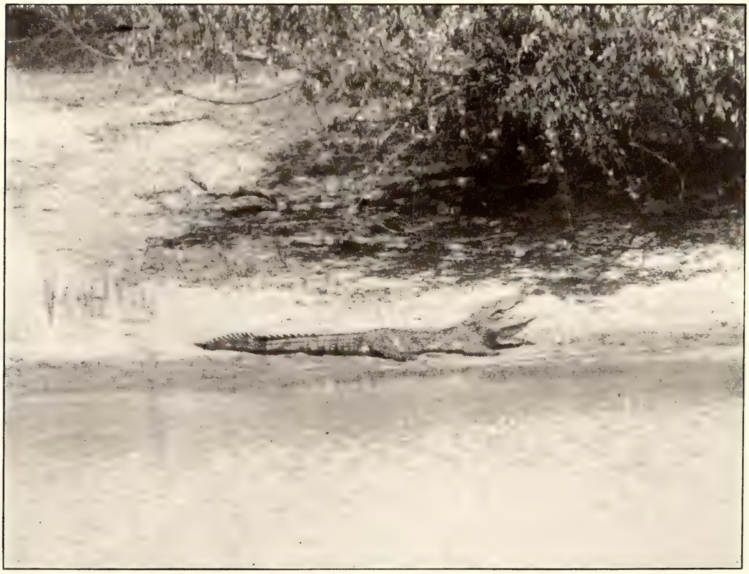


Wild Elephants (*Elephas maximus zeylanicus*) on the Menik Ganga.



A Crocodile basking.

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Of late years much of the country in which it lives has been opened up into rubber estates and cinnamon gardens, with a consequent serious decrease in the area suitable to the deer.

Owing to its skulking habits it still manages to preserve its existence but in most districts it is becoming increasingly rare. In addition to the opening up of its habitat, it is subjected to much persecution by the local villagers who kill it for meat whenever they get the chance. Unless some scheme for protecting the survivors can be devised it is a matter of a few years only before the species is exterminated in Ceylon.

Barking Deer.—The Ceylon representative of the little Muntjac or Barking Deer (*Muntiacus malabaricus*) is found locally over the greater part of the Island and, being small, has managed to survive in fair numbers in spite of much poaching and shooting during the so called close season. This small species is not much troubled by sportsmen, except in one or two districts in the lower hills where it is hunted. But it is the great prize of the Tamil cooly of the Tea Estates bordering upon the jungle. It has been more or less killed out in some districts but, generally speaking, it is more or less holding its own in spite of everything.

The foregoing are reckoned as 'Game' as a license is required before they can be shot. Nominally they are all subject to a Close Season and are protected under the Game Ordinances. Unfortunately however, as there is no one whose special duty it is to see that the provisions of the Game Ordinances are observed, the enforcement of the Ordinance, as a whole, is extremely lax—hence the serious diminution in the numbers of the deer.

Pigs.—(*Sus cristatus cristatus*) are not considered as game nor are they protected by a close season or any other regulation. They are classed as vermin on account of the damage that they do to crops; but, even so, thanks to their wonderful fecundity and adaptibility, they are well able to hold their own as long as any suitable cover, into which they may retire during daylight, remains in any district.

They are little troubled by sportsmen—a big boar is occasionally hunted and killed with the sambhur hounds or shot in the Low Country, but as there is no possibility of pigsticking, anywhere in the Island, the pig is held in but little regard by European sportsmen. On the other hand he is a useful addition to the larder of the villager and the Tamil cooly of the Estates and it is by them, the leopard and disease that his numbers are kept within bounds. There is no fear of his being exterminated until all the other large fauna has ceased to exist.

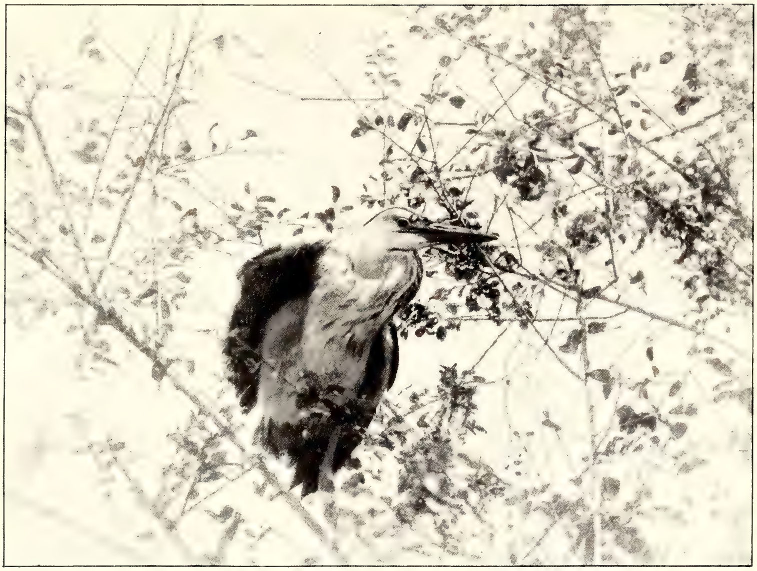
Leopards and Bears.—Likewise the Leopard (*Felis pardus pardus*) and the Sloth Bear (*Melursus ursinus*) being carnivorous and at times dangerous to man, are reckoned as vermin and are in no way protected. Every man's hand is against them but, owing to the large tracts of jungle still remaining in their habitats, there is little fear of either species becoming seriously depleted in numbers for many years to come. Both species are commonly shot by sportsmen over waterholes in the dry season—not a very sporting way of shooting them, perhaps, but in this country almost the only way, owing to the thick jungles in which they live and in which it is most difficult to find them. Leopards' skins have a marketable value of Rs. 25 to Rs. 30 each, but as the leopard is much too cunning to part easily with its skin this price upon its head makes very little difference to its numbers.

Monkeys.—With the larger species of wild life the monkeys must be included. Ceylon has three species, one Macaque and two Langurs or Wanderoos. The Ceylon Macaque or Toque monkey (*Macaca sinica*) is found in the heavy jungles throughout the Island and, solely owing to the fact that he is considered uneatable by all castes, is almost immune from persecution except in a few cases of wanton slaughter. With the Langurs it is otherwise; their flesh is considered as good food by some castes and as good medicine by others; as a consequence both species have suffered greatly. The Bear Monkey (*Pithecus senex monticola*) of the hills has been entirely exterminated in the remaining forests in many of the hill districts and the race has now a very restricted range which grows smaller each year. Almost the same may be said of the Purple-faced Monkey (*Pithecus senex vetulus*) found only in the damp, steamy jungles of the South-West Low Country; great numbers have been shot by the Tamil coolies in the planting districts, in spite of the Sinhalese Buddhists who are generally fond of their Wanderoos and often protect them to a certain extent. In the dry zone of the Low Country where the Madras Langur (*Pithecus entellus pallipes*) is found, the killing has not been quite so bad but many are shot down annually. None of these monkeys are in any way protected at any season of the year.

It must not be thought that sportsmen and others in the Island have sat quiet and done nothing while this decimation of the larger fauna has gone on. It is a matter that has, and is, receiving serious consideration in many quarters. The Ceylon Game Protection Society and the Ceylon Natural History Society, in addition to making other representations, have drawn up a joint memorandum, setting forth their combined views and urging the institution of a Game Department, and have forwarded it to Government; the Society for the Protection of the Fauna of the Empire has also made representations in the proper quarters.

Government, being now fully conversant with what is taking place, has appointed a Select Committee to examine the whole question together with the existing Game Ordinances. It is very sincerely to be hoped that the present Ordinances will be amended without undue delay and that machinery will be provided for the enforcement of the Game laws before any of our indigenous species have been completely wiped out of existence.

I am greatly indebted to Mr. G. M. Crabbe the well-known Ceylon sportsman and President of the Game Protection Society for the interesting photographs of Ceylon Game and Wild Life, which accompany this article. Mr. Crabbe is one of those who have laid aside the rifle in favour of the camera—with marked success.



Young Grey Heron.

Young Pelicans.

Copyright. *G. M. Crabbe.*

GAME PRESERVATION IN THE NILGIRIS IN 1929

BY

MAJOR E. G. PHYTHIAN-ADAMS, I.A. (Retd.), F.Z.S.

In the Journal for 20th October 1927 an article appeared on this subject, and in view of the present interest taken in the question of Game Preservation throughout India, it may be worth while considering the present position in this area as compared with two years ago.

In the concluding paragraph of my previous article I stated that 'The present condition of game in the area is satisfactory, but the greatly increased number of licensed and unlicensed weapons in the hands of patta-land shooters renders necessary stricter supervision than formerly, and an Act to regulate the sale of big game throughout the year, with severe penalties for the use of a gun except by a license holder in person. Unless some such steps on the lines indicated are taken at an early date the head of game in the area will diminish rapidly'.

Unfortunately no action has been taken in the matter with the result that a considerable decrease is already noticeable in the case of sambur, spotted-deer, and muntjac, while the position of the Nilgiri ibex has been most adversely affected by the unfortunate action of the Madras Government in throwing open to tea cultivation the previously uninhabited area known as the Kundahs Reserve, on the cliffs of which most of the ibex are located.

BIG GAME

Sambur.—On the plateau a distinct decrease is noticeable, and it has been found necesasry to limit the bag to one stag on the plateau and one in the low country on a Season license. In November last a gang of Kurrumbas from the Bhavani valley had cleared the country round Bison Swamp of all game. They were surprised by the writer at their work but unfortunately no arrests could be effected.

The hills west of the Pykara and Mukerti rivers are systematically poached by gangs of twenty or more armed coolies from the adjacent tea estates. The few Game Watchers and Forest Guards available can do little in the face of such numbers, and consequently arrests are seldom made. When they are, the small fines imposed act as no deterrent, as the profits from the sale of meat are so large.

Nor is the poaching of sambur confined only to the lower classes. There is unfortunately little reason to doubt that more than one license-holder has used his license to cover indiscriminate slaughter of hinds and undersized stags, the meat being sold in adjacent Badaga villages. Such cases are exceedingly difficult to detect as all concerned have so great an interest in concealing the offence.

In the low country in addition to poaching by patta-land shooters, sambur now suffer considerably from shooting by night from motor-cars. This unsporting method of hunting, which cannot be too strongly deprecated, unfortunately appears to be on the increase, nor is it confined solely to non-license holders.

Spotted deer.—Though there has been no increase in the number of their natural enemies the wild dogs, the deer have decreased very noticeably at Mudumalai, Kargude and Anaikatti, and there can be no doubt that this is due to heavy poaching by patta-land shooters whose guns can be heard any night throughout the year.

Bison.—No decrease noticeable, poachers giving them a wide berth.

Ibex.—If one considers the very small number left in the eighties, their great increase since then is a remarkable proof of what careful Game Preservation can effect. Their almost entire immunity from poaching up till now has been chiefly due to their keeping to areas far from human habitation, but with the opening up of the Kundahs for tea their position is bound to change for the worse. Their cliffs are now within a few miles of cultivation, and poaching by estate coolies which is inevitable and most difficult to control, as has been already seen in the case of sambur, is bound to affect them most adversely; and it is no exaggeration to say that if any further grants of land are made in the Kundahs, the ibex will soon be exterminated in this area.

Black buck.—The few there are appear to be holding their own, but are certainly not on the increase.

Jungle sheep.—Round Ebband, Muntjac, locally known as Jungle sheep, have been practically exterminated by poaching, and all over the plateau there is a marked decrease in their numbers. The bag allowed has now been reduced from six and three to four and two on a season and monthly license respectively.

Wild dogs.—A slight decrease is noticeable owing no doubt to the reintroduction of a reward for their destruction. The Mysore Government now gives a reward of Rs. 50 for a bitch and Rs. 30 for a dog, and the N.G.A. has recently raised its reward from Rs. 10 to Rs. 15, but unless the adjacent districts co-operate there is little hope of reducing this pest to reasonable proportions. It is much to be regretted that the representations of the N.G.A to the Madras Government with a view to the re-introduction of the Government reward have met with no success. If concerted action over the whole of Southern India were taken by Government in co-operation with the Indian States, Wild dogs, which in some districts have now taken to killing cattle, would soon be practically exterminated.

SMALL GAME

The proposal to import Burmese silver pheasants unfortunately fell through as no one could be found in Burma who was willing to supply eggs or birds. Jungle fowl are imported yearly from the low country and after ringing turned down on the plateau in areas temporarily closed for their protection, so far with only fair results. The success of H.H. the Maharaja of Patiala with imported English pheasants shows what can be done under suitable conditions, and it might be worth the while of the N.G.A. to experiment with these also.

Interests of cultivators.—In the vicinity of cultivation the interests of game preservation must necessarily be subservient to those of the cultivator. Deer do considerable damage to the crops, but little compared with the wild pig which have increased greatly in this district owing to the continual destruction of their natural enemy the panther. The pig live during the day in Reserve Forest where the cultivator cannot pursue them unless in possession of a license, and come out at night to ravage the fields. The damage they do is immense and unless actually fired at nothing seems to scare them away. It is suggested that where cultivation suffers severely from this cause, on a report being made to the D.F.O., the N.G.A. should arrange for adjacent Reserve Forests to be beaten through and the pigs shot. If sufficient members of the N.G.A. do not volunteer, then non-license holders should be permitted to participate in the shoot. It must be admitted that the cultivator has a real grievance in the matter, which it is the duty of the N.G.A. to alleviate as far as lies in its power.

The issue of gun licenses for crop protection needs no justification, but it is equally necessary that these weapons should be controlled. Only a very small proportion is used solely for the purpose for which intended, and much poaching goes on in adjacent Reserve Forests throughout the year, large profits being made by the sale of meat and skins. It has been proposed that all weapons licensed for crop protection should be called in during the hot weather when there are no crops to protect but when game is easily shot over water, etc. This precaution would no doubt be most effective in many parts of S. India, but it hardly applies even to the low country of this district, where perennial streams abound. A more effective safeguard would be to limit the length of gun barrels to, say 12 inches, which would be ample for crop protection but of little use for poaching.

Sale of meat.—But the chief thing is to stop the sale of meat from which large profits are made and for the sake of which alone this form of poaching continues. An Act is already in force prohibiting the sale of game anywhere in the district out of season i.e., from July 1 to October 31 for big game, and from March 1 to August 31 for small game, but this is not sufficient, and the Act should be amended to cover the whole year. Game throughout the Presidency would benefit enormously if such an Act were made applicable to all districts. In this connection the experience of the Ceylon Game Protection Society is of interest. Poaching had increased to such an extent some twenty-five years ago that the spotted deer were being rapidly exterminated. A Dried Meat Ordinance was passed in 1908 and poaching was at once reduced to reasonable proportions.

Protection.—As stated in the previous article, the N.G.A. decided in 1926 to dispense with its staff of seventeen local game watchers but who were found to be quite useless. It was hoped that by setting aside a special sum for rewards in poaching cases, their duties could be efficiently performed by ordinary Forest Guards. Before the end of 1927 however, it was found that poaching was definitely on the increase, and it was decided to engage four specially selected men of the 1-3rd Madras Regiment (then in process of disbandment) at Rs. 25 p.m. So far the results have not proved very satisfactory, but there is no doubt that game watchers are necessary. Until however a Game Warden is appointed to supervise and assist them, no marked improvement can be expected. It has been shown that the most serious poaching on the plateau is carried out by armed gangs of Kurrumbas or estate coolies. Any attempt by a couple of unarmed game watchers to effect an arrest under such conditions could have only one result, while in the case of a poaching license-holder they lack authority.

In a district like the Nilgiris where so many retired officers and others have settled, it should not be difficult to find someone who would be willing to undertake the duties of Game and Fish Warden, and to assist the D.F.O. (who is already greatly over-worked) in the office work of the N.G.A. Such an appointment would have to be Honorary as the N.G.A. could not afford to pay a suitable salary, though it might run to a small sum, say Rs. 50 p.m., for travelling and out-of-pocket expenses. The grant of free shooting and fishing licenses in addition should be sufficient to attract a suitable candidate. Under the Rules now in force the Warden should be appointed as a Forest Officer with power to arrest offenders. Such an appointment would be of the greatest benefit to game and fish preservation in the area, ensuring proper control over the watchers and an effective deterrent to poachers.

Sanctuaries.—For many years the chief game reserve of the area has been the uninhabited tract of the Kundahs, which till 1927 was closed to all beating and small game shooting. Though not a sanctuary proper, the adjacent slopes covered with almost impenetrable forest and mostly inaccessible by man served as such, and in consequence the Kundahs were rightly considered the best stalking ground in the Nilgiris. In 1928 the Madras Government granted 2,300 acres of this area to Messrs. Brooke Bond for opening up in tea, and further grants in the vicinity have since been applied for. It would have been reasonable to expect that before any such grant was sanctioned, Government would have ascertained the views of the N.G.A. on the subject, but no such reference was made. From the point of view of game preservation the result of opening up this area is bound to be most serious, and any further grants will inevitably lead to the practical extinction of the Nilgiri ibex and other big game in this area. Protests have been addressed to Government by the N.G.A., the U.P.A.S.I., and the Bombay Natural History Society, and it is to be hoped that no further grants in this area will be made for any purpose whatsoever, and that what remains of the Kundah Reserve Forest will be declared by Government a permanent game reserve under the control of the N.G.A In order adequately to protect the Nilgiri ibex and sambur on the plateau, the Porthimund, Pichalbettu, Mukerti, and Nilgiri Peak Reserve Forests covering the Western cliffs should also be included.

All these are far removed from Badaga cultivation, so that no objection can be raised on the grounds of their affording refuge to crop destroying animals.

Financial.—At present though the N.G.A. gives rewards for reporting cases of poaching, all fines inflicted are credited to Government. This is unreasonable and should be set right by all such sums recovered either in shooting or fishing cases being handed over to the N.G.A. The present cost of a season license is Rs. 50 and of a monthly one Rs. 30, and in view of the comparatively small bag allowed, there appears no justification for an increase of fees.

Conclusion.—In order adequately to safeguard the game in the Nilgiris, the following appear essential :—

1. The existing Act regulating the sale of game to be amended to cover the whole year.
2. Weapons licensed for crop protection to have short barrels.
3. Re-introduction of Government reward for wild dogs throughout the Presidency.
4. Establishment of game reserves.
5. Appointment of a Warden.

THE TOXICITY OF THE VENOMS OF INDIAN SCORPIONS

BY

REV. J. F. CAIUS, S.J., F.L.S.

No. 1—*Butheolus melanurus*, Kessler

I received on June 25, 1929, three specimens of *Butheolus melanurus*, Kessler, forwarded by the Medical Officer, Shevgaon, Ahmednagar. While attempting to extract the venom one of the stings got firmly implanted into the forefinger of my left hand into which the venom was discharged. I felt a sharp burning pain for the space of a few seconds; this was followed by throbbing and dull pain. Within two minutes from the time of the injection all that was noticeable was an indefinite feeling of discomfort in the region of the sting; and this persisted for one hour and twenty minutes. The action of the venom was entirely local.

As the amount of venom is so very small as not to yield to any of the methods of extraction I have thought it worth while to record this unique experience with the venom of *Butheolus melanurus*.

I also append a few remarks which are not without interest.

Colour :—♀ : upper side of trunk dull black (deep green in alcohol); tail black with metallic sheen (bluish green in alcohol); vesicle deep reddish-brown; legs lemon yellow, femora fuliginous, patellae of first and second pairs fuliginous, distal segments quite pale; humerus and brachium black, hand brown, fingers paler; abdominal sterna brown, shining, the last dull black with shining crests; pectines clear yellow (with green tinge in alcohol).

♂ : legs yellower; chelae uniformly brown; last abdominal sternum very deep brown.

Trunk :—♀ : entirely covered above with close-set granules, the two interocular ridges alone being smooth; terga with a median crest, 3–6 faintly tricarinate, last strongly keeled; sterna finely granular, smooth and polished in the middle of the posterior half, punctured at the sides, the first punctured in the middle, the last granular with four crests.

♂ : terga with a single median crest; the last sternum with evanescent crests.

Tail :—thick; posteriorly incrassate; the fourth and fifth segments subequal in width and wider than the rest; the first and second segments with ten granular keels and granular intercarinal spaces; the third partially pitted, the fourth and fifth pitted; the fifth with inferior lateral keel, but weak in front; lateral surface pitted; inferior surface granular in the intercarinal spaces; vesicle small, piriform, pitted.

Chelae :—Humerus with granular crests; brachium with smooth crests; hand smooth, punctured, narrow, as broad as brachium; underhand half the length of the movable digit, excelling width of hand; movable finger as long as carapace, furnished with nine rows of teeth, the basal row long.

Legs :—1–3 with granularly crested femora and patellae.

Pectinal teeth :—18 in ♀ and ♂.

Measurements in mm.—♀: total length 32; carapace 3·5; tail 20; brachium 2·5; underhand 1·5; movable finger 3; width of hand 0·6; width of first caudal segment 2, of fourth 3.

♂: total length 30; carapace 3; tail 19; brachium 2·5; underhand 2; movable finger 3·5; width of hand 0·8; width of first caudal segment 2·5, of fourth 3.

Locality :—Shevgaon (Ahmednagar).

Progress of the Society's Investigation

Since the publication of my last list on page 680 of this Volume, the undermentioned quantities of poison have been collected by me from live specimens received through the co-operation of members and the Medical Departments of the various Provincial Governments.

	Number of scorpions	Weight of dry venom in milligrams.
Butheolus melanurus ...	3	0·0
Buthus pachyurus ...	57	25·5
,, *rugiscutis* ...	12	2·6
,, *tamulus* ...	275	605·3
Palamnaeus bengalensis ...	2	9·7
,, *fulvipes* ...	48	146·7
,, *gravimanus* ...	4	14·6
,, *liurus* ...	19	12·5
,, *longimanus* ...	5	18·5
,, *phipsoni* ...	10	48·6
,, *swammerdami* ...	35	483·4
,, *xanthopus* ...	4	14·5
Scorpiops asthenurus ...	5	5·6
,, *montanus* ...	7	3·6
Isometrus europaeus (vesicles)	10	7·9

REVIEWS

CENTENARY HISTORY OF THE ZOOLOGICAL SOCIETY OF LONDON.—By P. Chalmers Mitchell, pp. i—xi,—307, with a Statistical Chart, 32 Portraits and 9 Plans. Printed for the Society, and sold at its House in Regent's Park, London. 1929. Price Rs. 25.

The origin of the Zoological Society is somewhat obscure, but according to Dr. Mitchell's recent researches, it was not an offshoot from the Zoological Club of the Linnean Society, as generally supposed, but originated in a scheme started by Sir Stamford Raffles and Sir Humphrey Davy, neither of whom were members of the Zoological Club, sometime previous to 1825.

Be that as it may, in July 1824 a meeting of friends of a proposed Zoological Society met in London and drafted a prospectus for this new Society and appointed a Committee with Sir Stamford Raffles as Chairman.

It was not however till 1829 that the Society was incorporated by Royal Charter, thereby acquiring a legal status, and this was the date fixed upon by the Council as the foundation of the Society for the purpose of the centenary which has been celebrated this year.

The arrangements for this important event consisted of a special meeting held in the Great Hall of London University on the afternoon of April 29 at which the President, the Duke of Bedford, gave an address on the History of the Society followed by an account of the scientific work of the Society by the Secretary, and congratulatory addresses by delegates from many British and Foreign Societies. In the evening a dinner was held at the Zoological Gardens presided over by the Duke of Bedford, and H. R. H. the Prince of Wales was the principal guest. After a number of interesting speeches, an adjournment was made to the Aquarium and Reptile House, which were specially illuminated, and in spite of the unfortunate break in the weather, the whole proceedings were most successful and were thoroughly enjoyed by everyone who had the privilege to be present.

The numbers of Fellows on the Society's roll are over 8,000, and as the accommodation at the dinner was restricted, a garden party for the Fellows is being held at the Gardens in the evening of June 20, but at the time of writing this final of the celebrations has not yet taken place.

As a further commemoration of the Centenary the Council of the Society decided to issue (I) a Centenary History of the Society written by the Secretary and (II) a new and revised edition of the List of Vertebrate Animals. This last is being brought out in three volumes—No. 1, Mammals by Major Stanley Flower, late Director of the Egyptian Zoological Gardens at Cairo and a former member of our Society ; No. 2. Birds by Dr. George Carmichael Low and No. 3 Reptiles, Amphibia and Fishes by Mr. G. E. Boulenger, Director of the Aquarium, Dr. Malcolm Smith, a member of our

Society, and Mr. J. R. Norman of the British Museum respectively. These last three volumes we hope to notice later, but only the History is reviewed in the present article.

The prospectus issued on August 23, 1824, already referred to, was followed by another on February 1, 1825, in which the objects of the Society were set forth and anyone wishing to become an original member was asked to send in his name. This appeal resulted in a first list of 151 subscribers, among which were a number of the leading naturalists of the day, as well as the Duke of Bedford, the Marquis of Landsdowne and many members of parliament, including the Home Secretary and the Postmaster-General, so that the Society may be said to have had an auspicious start.

From a perusal of various early documents it will be seen that the Society proposed to form a collection of living animals to be established in the vicinity of London, to which members should have access, and also the public on certain conditions; in addition a museum was to be started as well as a library and the new Society was to stand in the same relation to Zoology as the Horticultural Society does to Botany.

Various attempts were made to find a suitable place for the proposed garden, but finally in 1826 the Commissioners of Woods and Forests granted the Society 5 acres of Regents Park, situated on the outer circle, between the old tunnel and the main gate and here a start was made with the now world-famous Zoological Gardens.

In chapter vi. Dr. Mitchell gives the history of the gardens from the commencement and traces the various developments and changes which have finally led up to the present arrangement with the wonderful aquarium, reptile house and new tropical bird house.

The management of the Society was first vested in a Committee and an Honorary Secretary, the first being N. A. Vigors, a well-known ornithologist of his day. He was followed by E. T. Bennett, William Yarrell and others till 1847, when a paid Secretary was authorized and D. W. Mitchell was elected to the post at a salary of £250 per annum. Mitchell is perhaps better known as a very accurate zoological artist who illustrated G. R. Gray's three folio volumes on the Genera of Birds than as Secretary to the Society, though nevertheless he played an important part in the history of the Society.

In 1859 Mitchell resigned to take up the appointment of Director of the newly founded Jardin d'Acclimatation in Paris, where he died later in the year. In his place Philip Lutley Sclater was appointed and after a long term of office he resigned in 1902 and was succeeded by his son Mr. W. L. Sclater, at one time in charge of the Indian Museum, Calcutta, but in the following year Sir P. Chalmers Mitchell, the present Secretary, was appointed to the post.

The activities of the Society may be divided into four decades: the first, up to 1847 when the secretaryship was an honorary post and the Society was in a transition stage; then on the appointment of D. W. Mitchell, the second decade begins and in the words of the present Secretary 'there is no doubt of the value of his (D. W. Mitchell's) services to the Society. The scientific meetings and publications were kept at a high standard and the number of fellows greatly increased. The improvements at the gardens were notable, and the number of visitors and revenue grew, the number of animals in the gardens were added to and the publications enlarged. He persuaded the Council to change the rule by which the public required a Fellow's order as well as payment to gain admission. He aroused the interest of the press in particular animals and in events in the gardens and laid the foundation of a period of prosperity '.

With the appointment of Dr. Sclater, the Society may be said to have entered on the third decade and took a new lease of life ; the membership and revenue increased, the number of animals in the gardens were added to and the publications enlarged. During the whole of Sclater's time as Secretary the offices of the Society were at Hanover Square, an arrangement which made it difficult for the Secretary to properly supervise the gardens. Fortunately during the greater part of this period the animals were under an excellent superintendent, A. D. Bartlett, whose name will always be connected with the keeping of animals in captivity. But if Sclater did not bring any striking innovations to the gardens, he will always be membered from the purely scientific side of the Society's activities. Dr. Sclater was one of the leading zoologists of his time and had a world-wide reputation as an authority on mammals and birds and his position as Secretary enabled him to do much to further the study of these two groups. He was in touch with all the leading naturalists and travellers abroad and in this way obtained many interesting and new animals for the gardens and valuable papers for the Society's publications. It would, however, have been better if he had resigned sooner as he was getting on in years and the housing of the animals was not advancing with the times.

With the appointment of Sir P. Chalmers Mitchell to the post of Secretary, the Society entered on the fourth decade, which has been noteworthy for many reforms both in the general management and the entire reorganization of the gardens. The present Secretary differs from his predecessors in that he is not only a first rate zoologist but also a good business man as well, a combination not often found. During his tenure of office many notable changes have been carried out, such as the removal of the Society's offices from Hanover Square to the gardens, a move which, however inconvenient to Fellows wishing to consult the library or attend the meetings, it must be admitted, has been in the best interests of the Society, the building of the Mappin Terraces, the Aquarium, Reptile House, etc. Certain of these improvements were not carried without opposition from some of the Fellows, but all have in the end been justified.

Chapter V concerns the library and scientific publications and we think that hardly sufficient credit has been given to Dr. Sclater for his share in enlarging the library and developing the Proceedings. We should have liked more details given in regard to the publications and some of the more important papers mentioned, for is it not by the Proceedings and Transactions that the Society is known all over the world ?

The difficulties of running the Zoo during the war are described in Chapter VII, and in the two following chapters Dr. Mitchell gives us his views on keeping tropical animals—the necessity of allowing them plenty of fresh air and at the same time access to warmth—and gives details of the construction of the new Monkey and Reptile Houses. All this is very valuable and should be carefully studied by those in charge of zoological gardens in all parts of the world.

Under the heading ' Research ' we learn details of some of the activities, behind the scenes so to speak, enquiries into the health of animals and the use made of their bodies when they are dead, for furthering the study of anatomy, pathology, etc. This valuable work is carried out by the Society's officers, the results of which are published from time to time in the Proceedings.

The final chapter deals with Whipsnade Zoological Park and its future developments. Sir P. Chalmers Mitchell first tells us how the idea of the park originated ; he then goes on to describe the 480 acres, which the Society has purchased, and finally gives an idea of how the ground is going to be developed.

Roughly speaking, this offshoot of the Zoo will be used for showing animals in natural surroundings and all duplicates will be transferred there. In Regents Park a large number of different animals, single individuals or pairs, will be exhibited including those which need special housing such as rhinoceroses, hippopotamuses, tropical birds, etc., whereas at Whipsnade fewer kinds but large numbers of each will be on view. Instead of being in cages they will be in panorama paddocks and waries trying as far as possible to have the amimals in the suitable surroundings.

We trust no attempts will be made to introduce any animals at full liberty, enough harm has already been done by introduction of the Little Owl and Grey Squirrel—we want no more aliens !

One of the most interesting features of this volume is the chart at the beginning showing the growth of the Society, in members, visitors and funds under the successive Secretaries. Attention too must be drawn to the very interesting series of portraits of past and present officers of the Society and great credit is due to the author for making this complete.

We can recommend this volume to all those who are interested in the Zoological Society of London, and we have no doubt that any one connected with the administration of a Zoological garden will find much useful information.

N.B.K.

2. THE COWBIRDS.—By Herbert Friedmann (Charles C. Thomas, Publisher of Springfield, Illinois, U. S. A. ; European Agents—Bailliére, Tindall and Cox, Covent Garden, London, £1-7-0).

We have received for review a copy of Mr. Friedmann's book on the Cowbirds, which is a monograph consisting of xvii and 421 pages with 28 black and white plates printed from photographs and thirteen figures in the text. It measures 9½ by 6½ inches and is unusually heavy for its size. On first picking up the book, one is led from its binding and appearance to think that it is of the popular gift book class, for they are of a type to which we are not accustomed on this side of the Atlantic to associate with scientific works. The first glance inside is however sufficient to dispel the illusion. Mr. Friedmann's book is, to quote his sub-title, a Study in the Biology of Social Parasitism, and this explains the reason why we are mentioning it in the Journal; for it is not our custom to review American Ornithological literature, which is not as a rule of interest to our members.

The Cowbirds form a natural group of the family *Icteridæ* or Hang-Nests, a family which does not occur in India but is familiar to most of us through that well-known bird the Baltmore Oriole. Their popular name is due to a habit of association with cattle. The Cowbirds consist of three genera, *Agelæoides*, *Molothrus* and *Tangavius*, which form a link between the *Icteridæ* and *Fringillidæ* (Finches). They have however attained an importance in the study of Ornithology exceeding that of most similar groups owing to the fact, discovered over a century ago, that they were parasitic in their breeding habits. It is this aspect of the Cowbirds which leads us to draw the attention of our Members to Mr. Friedmann's book.

The fact that the Common Cuckoo is a parasite, laying its eggs in other bird's nests, was known as long ago as in the time of Aristotle; and this knowledge is very widespread in the world even amongst people ignorant of all other aspects of bird life, though curiously enough it is not commonly known to the indigenous races of the Himalayas where cuckoos are common. Recent years have seen the output of a great quantity of literature connected with the parasitic habits of cuckoos, more especially with reference to the European species, *Cuculus canorus* and there has been a great deal of speculation as to how the habit originated, its effect on the Cuckoo and on the fosterers selected. In spite of much controversy we are however still far distant from the solution of these problems and it is evident that the attack on them to be successful must be delivered from a number of angles. Of these the most obvious is to discover how far parasitism of the cuckoo type is practised by other classes of birds: and then to study its causes and effects in those groups, correlating the results with the study of the Cuckoos.

It was only about a century ago that Alexander Wilson introduced to the scientific world a fact which had been known for some little time to local observers that the Cowbird (*Molothrus ater*) was parasitic on other birds, laying its eggs in their nests. Later still it was discovered that some of the African Honey-guides (*Indicator*) and Weavers were also parasitic and only a few years ago a South American Duck was found to be likewise parasitic. Possibly a few other cases remain to be discovered. It is obvious that no study of parasitism in the Cuckoos will be successful or satisfactory unless it takes cognisance of these other distinct cases.

It is fortunate for all students of the problem that Mr. Friedmann decided to take up an intensive study of the Cowbird group, and Mr. Friedmann himself has been most fortunate in the opportunities which he has deserved and obtained of prosecuting those studies. We propose to detail briefly the methods which Mr. Friedmann has followed in his studies and the results that he has attained, in the hopes that the attention of our members may be attracted to the existence in India, Burma and Ceylon of great opportunities of adding to the existing but inadequate mass of knowledge on the problem of parasitism in the Cuckoos.

In Mr. Friedmann's preface he states very truly that the present state of the problem is far from satisfactory. A vast literature on the subject has grown up—a literature none too reliable in many places and truly scientific and accurate in but few parts. 'Twenty odd centuries of speculation tempered with as few facts as it is bolstered with as many fancies have produced a resulting mass that is far from satisfactory as a basis from which to work . . . . . . in the total bulk of published thought the unreliable and the non-scientific so far exceed the trustworthy that a survey of the literature of this subject is of more interest than profit to the Ornithologist.'

The European Cuckoo, he goes on to state, is the only parasitic species which had been subjected to intense study and close scrutiny. Considering that the problem would not however advance until other instances had been studied in the same intense and careful way and that it was of the first importance in this connection to study the Cowbirds, he took up this group. For, as he lays down as an axiom, prolonged intensive study in a limited region offers the only way to obtain the necessary data.

In Mr. Friedmann's study opportunity and ability have coincided in a manner not hitherto possible in the study of parasitism. The Cowbirds, as we shall see later, consist of a small and easily defined group ; they are confined to North and South America. They comprise various stages of normal breeding habits and parasitism and some variety of sexual relationships. The commoner species comprise a number of geographical races and in their parasitism a great number of fosterers are involved. The group in short offers a good epitome of the factors of the problem as a whole and on it there is also a mass of published information available.

Mr. Friedmann started his study of the Cowbirds at the Cornell University and after three years work there he was aided by the National Research Council to continue it, and a fellowship was granted to him to enable him to continue his studies and extend them to cover the South American forms. His book is based, therefore, on five years of uninterrupted work at the subject, in the course of which he spent three breeding seasons in central New York State, one in Argentina, and one on the Texan-Mexican border. The result is this record of achievement and of inspiration. We propose to summarize the results of Mr. Friedmann's study of the Cowbirds and use it as a sign-post to the work that still requires to be done in the Oriental Region on that long list of cuckoos described in vol. iv of the Fauna of British India, in the hope that some of our members may make use of the opportunities afforded them by residence in little known areas of the Empire.

Mr. Friedmann's method of studying the Cowbirds has been very thorough. He has treated each species as a separate entity, but under each species he has been careful to keep the various subspecies separate in case geographical differences of range might be shewn to affect the factors in any way. Each species has been thoroughly considered under a variety of headings—range, migration, courtship and making sexual relations, territorial relations, nests and nest building, eggs and egg-laying, food, plumage and moults, enemies and finally a careful synonymy with complete references. Under these headings he has grouped all that he could find of value in the published observations on the subject and has supplemented or corrected this by his own work in the field, drawing what deductions may appear to be warranted. The labour involved in the compilation of the annotated lists of the recorded fosterers of each race of each Cowbird must have been enormous, to mention one item alone.

The field work appears to have been exceptionally thorough. A special attention was paid to the habits of each species, most particularly under the headings of song, courtship and territory; and it will soon be realized how valuable Mr. Friedmann regards the conception of territory promulgated by Mr. Howard in his work on British birds as one of the chief factors in the life-history and evolution of a species. Numbers of specimens were also collected, not in a haphazard manner but to elucidate the various problems connected with the life-history of the birds and it is clear that Mr. Friedmann is not of that vast army which throw away the bird and keep only its feathers. The dissecting knife and the microscope were brought into use to substantiate the observations in the field on the breeding habits.

The main body of the book is devoted to a record of the results of these labours. Facts were the author's first requirement and facts are set down at complete length together with the evidence towards them. Then two chapters set down the deductions that are drawn from them. The first of these two chapters attempts to determine the phylogenetic relationships of the existing forms of Cowbird and it is headed, 'The Evolution of the present Cowbirds'. In this chapter evidence of the evolution of the Cowbirds is sought in a brief summary of the evidence from three factors, geographical (distribution), biological (habits) and structural (colouration). By this method the conclusion is arrived at that the Bay-winged Cowbird (*Agelæoides badius*) is to be regarded as the most primitive form nearest to the hypothetical ancestor of the group.

Having thus determined the most primitive of his group of Cowbirds Mr. Friedmann then endeavours to discuss the origin and evolution of the parasitic habit within the group, helped thereto by the decisions he has arrived at in the earlier chapters as to the exact degree of parasitism in each species. To obtain a better understanding of his results, it is necessary briefly to summarize what he has established.

Seven species of Cowbird are known belonging to three genera—*Agelæoides*, *Molothrus* and *Tangavius*. Of these two species are so excessively rare in collections with nothing known of their breeding habits that they may be at present disregarded. The five remaining species are as follows:—

The Bay-winged Cowbird (*Agelæoides badius*).—This species is not parasitic. Definite pairs occupy the nests of other birds, sometimes using deserted nests but usually fighting hard with the owners of the desired nest and driving them away. Having thus procured a nest, they proceed to establish a territory round it. Occasionally a pair builds its own nest, but the tendency is to obtain a coveted nest by force, and the nest chosen is usually of certain definitely preferred species, so that there is an element of parasitism in the breeding habits.

The Screaming Cowbird (*Molothrus rufo-axillaris*).—Definitely parasitic and only in the nests of the last Cowbird. Apparently two eggs may be laid in any one nest. In this species a territory is established some months before the eggs are laid. The eggs and young of the fosterer Cowbird are not harmed by the parasite, but the young of the two species are reared side by side and are absolutely indistinguishable to human eyes. This likeness is due not to mimicry but to community of descent.

The Shiny Cowbird (*Molothrus bonariensis*).—Entirely parasitic on a great number of Passerine birds. It shows great interest in nests, and nest sites as such, as if retaining atavistic leanings to nest building, but is very wasteful of its eggs laying numbers in deserted nests, in nests already crowded with Cowbird's eggs, or on the ground. The highest number of Cowbird's eggs discovered in one nest is 37. Its sexual and territorial instincts are weak and easily broken. When laying in a nest it pecks at other eggs in the nest including Cowbird's eggs. The fosterer's own offspring do not survive in the presence of the parasite.

The North American Cowbird (*Molothrus ater*).—Parasitic on a large number of Passerine birds but its instincts are not as debased as in the last species. It has definite territories and does not usually deposit more than one egg in each nest, usually removing one of the original eggs. The fosterer's own young do not survive in the presence of the parasite.

The Red-eyed Cowbird (*Tangavius æneus*).—Parasitic chiefly on the other *Icteridæ* but also on other Passerine birds. Habits not fully studied.

All the Cowbirds are believed to be monogamous but occasionally tending to polyandry as the males are in excess of the females, except in the Red-eyed Cowbird in which the females are very greatly in the majority.

Now the brief summaries given above show that there are various stages in parasitism within the group, ranging from the slight development in which the Bay-winged Cowbird robs other birds of their nests to the well developed state of the Screaming Cowbird which has arrived largely at specificity in hosts. Mr. Friedmann gives reasons for assuming that originally all Cowbirds were normal in their nesting habits, an assumption with which we entirely agree, and fortifies this by his previous decision that the Bay-winged Cowbird is nearest the parent stock. This then simplifies the problem which becomes simply one as to how they lost their original habits and became parasitic. From here onwards we are on more debateable ground. Mr. Friedmann's theory is that parasitism in the Cowbirds is a direct result of their failure to realize the importance of territory in bird life ; they have reversed the natural process which is to establish a territory and then select a nesting site within that territory. The result of this reversal is that territory, instead of being the primary consideration, has become of only secondary importance and with this reduction of its significance the instinct to defend it is correspondingly lessened. We are not prepared to attach the same importance to ' territory ' as Mr. Howard and Mr. Friedmann, and we cannot connect it with the next stage in his argument which is apparently that the failure of the bird to realize the significance of its territory weakens the protecting instincts of the female and finally those of the male. Then, he argues, when the protective instinct is lost a lesser comes into play, to conceal the eggs in the nests of other birds in order to benefit (we presume) from their greater appreciation of the necessity of ' territorial protection.'

We do not feel that Mr. Friedmann has settled the origin and evolution of the parasitic habit amongst the Cowbirds, though we admit that he has set up a wonderful record of data from which the problem must be surveyed. The interest of his book for us in India lies in the fact that the evolution of the parasitic habits of the Cowbirds and the Cuckoos has doubtless proceeded on somewhat parallel lines, that he has shown us how to accumulate and marshall the necessary evidence for the solution of the problem, and that, when we have set up a similar record for our Asiatic Cuckoos, we shall have ready before us this record of the Cowbirds as a second corner stone from which to build the edifice at which we aim.

In the meantime, however, to quote the final paragraph in the book, the field zoologist can help to direct the steps of the physiologist by getting a composite picture of the various stages and degrees of parasitism exhibited by the different species of parasitic birds and by comparing and contrasting them to understand as far as he is able their significant points of resemblance and change. Careful, accurate fieldwork is needed on all parasitic birds before we can hope to advance very far in our study. So ends Mr. Friedmann, and here we may well pause and take stock of our position as Indian Ornithologists.

Complete parasitism is known to exist in India only in the family of the *Cuculidæ*. It probably is practised by that little known Himalayan Honey-guide (*Indicator xanthonotus*), whose breeding habits are quite unknown, and remembering the parasitic habits of certain African Weavers, we must bear in mind the habit of some individual Munias of laying freely in each other's nests. Our chief preoccupation must however lie with the Cuckoos.

In the new edition of the *Fauna* we find 15 species of Cuckoos, apart from subspecies, enumerated from the territories treated in that work. These are divided into three sub-families—the *Cuculinæ* the *Eudynaminæ* and the *Phœnicophainæ*. The first of these contains all the parasitic cuckoos popularly so known, whilst the last contains a selection of curious non-parasitic ground-cuckoos, one genus of which *Centropus*, from its wide distribution, is commonly regarded as one of the most primitive forms of cuckoo. It will be noticed that a new subfamily *Eudynaminæ* has been made to accommodate the well-known Koel which, in the first edition of the *Fauna*, was included on structural grounds in the *Phœnicophainæ*. The sole reason for separating the Koel from the *Phoœnicophainæ* appears to be the fact that it is arboreal and parasitic and the change appears regrettable and artificial, tending if anything, to obscure an interesting factor in the problem of parasitism. A Biological factor should not be used to show philogenetic relationship.

The breeding habits of the *Phœnicophainæ* are well-known and fall into two main types—the construction of a slight almost dove-like nest and the construction of a large domed nest. In both types the eggs are incubated by the parents in the normal monogamous way, and it is important to remember that the eggs are all of the same type, whitish chalky eggs very different in appearance and proportionate size from those of the parasitic cuckoos. The importance of this group lies in the link which it preserves with the breeding habits of the non-parasitic cuckoos of the New World, some of which have social breeding habits which must be kept in mind in all studies of the parasitic cuckoos. To leave the Koel with this group to which it belongs morphologically is infinitely more important to the study of the problem than to separate it on the base of its parasitic habits. Mr. Friedmann's clear recital of the difference of breeding habits within the small group of Cowbirds is alone sufficient to wipe out this arbitrary distinction.

Our knowledge of the Asiatic *Cuculinæ* cannot be considered in a satisfactory state. Inspired by Mr. Stuart-Baker's interest in this group, a number of field-naturalists in different parts of India have produced a great number of observations on the breeding habits of the various cuckoos in their neighbourhoods and great numbers of cuckoo's eggs have been collected. The result has been to clear up many points : in others, perhaps confusion has been made worse confounded. The most casual perusal of all that has been written about the oology of Asiatic parasitic cuckoos will clearly show one of two things—either that much of the data collected is erroneous or else that the problem is far more involved than was originally suspected. Exceedingly different types of egg are credited to the same species of cuckoo in different areas. If it is correct that there is such variation in the eggs of one species as at present attributed to it, we have not one but several problems to attack. But before we attack those problems, we need to make certain that they really exist and that there has not been some mistake.

Now we cannot help feeling that many of these problems are based on erroneous data and that the whole problem of our Asiatic cuckoos requires to be tackled *de novo.* Before we attempt to generalize about the eggs and breeding habits of all these cuckoos, we want to know more about the birds themselves.

Take two of the most familiar species, the Common Cuckoo (*Cuculus canorus*) and the Pied-crested Cuckoo (*Clamator jacobinus*). As to the first we do not know accurately what is its breeding range in our area nor what races are represented. Its migrations have not been studied in Asia and its seasonal distribution is not fully known. We cannot even speak with confidence as to the curious fact that in the Western Himalayas it breeds apparently in two distinct altitudinal zones with a wide gap between them.

With the Pied-crested Cuckoo our ignorance is even more striking. It is one of the best known birds of India with its conspicuous black and white plumage, its loud calls and its abundance : yet we do not yet know the very elementary fact whether this bird spends its life cycle in India or whether it passes half its year in Africa. On the present state of our knowledge one might draw the conclusion that it spends half the year in India, breeds there and lays a blue egg, that it spends the rest of the year in Africa, breeds there and lays a white egg. Such a conclusion is unacceptable, yet it is hardly more curious than some of the conclusions accepted with regard to the lesser known of our Asiatic cuckoos.

In our opinion the time is ripe for a fresh survey of the whole of the Indian cuckoos. The ideal would of course be for India to produce its special student of the group, one who like Mr. Friedmann could devote several years to this problem alone, studying each species intensively in carefully selected areas and then at the end publishing his results. This ideal is perhaps unattainable, but much might be accomplished in other ways. Many of the keen egg-collectors amongst our members might take up observation of their local species of cuckoo on the lines followed by Chance and Friedmann ; all the Ornithologists on our rolls might furnish notes as to the distribution and status of the cuckoos in their areas ; while someone debarred from fieldwork might assist in the careful collation and sifting of all the published records winnowing from the mass the residue of value, small as it ultimately may prove to be. Let us work out the life-histories of our Cuckoos themselves with their distribution and migrations ; then we shall be on surer ground in dealing with their breeding habits. When these are surely known, then can we proceed to draw our deductions and conclusions. And when our data are ready, we shall turn again to Mr. Friedmann's monumental work, assisted by his facts about the parallel evolution of the parasitism of the cowbirds, and in our turn assisting to throw light on the dark patches in his argument. The Pyramids were built by the piecing together of separate stones.

H. W.

3 THE PLANT IN RELATION TO WATER.—By N. A. Maximov. Authorized English Translation, edited with notes by R. H. Yapp, 431 pages. George Allen and Unwin, Ltd., London, 1929. Price 21 s. net.

The main purpose of the book, as the author puts it, ' is to give those engaged in experimental research, as well as students of botany and agriculture, an account of what has been and still is being done in the elucidation of problems connected with the drought resistance of plants '. This might lead to the conclusion that the book before us is chiefly a work of compilation. But this is not the case. The writer is an acknowledged authority in this field of work and we cannot expect him to be satisfied with merely enumerating the ideas and opinions of those who have gone before him. The greater part of his work is an historical and critical account of the development of our knowledge of the relations between plant and water. His constant historical references introduce the reader to a considerable number of Russian Physiologists and their valuable researches, which otherwise would be practically unknown to all who are not familiar with the Russian language. It is only by translations of books of this kind that most of us get an occasional glimpse into the scientific work of the Soviet Republics and we cannot help admiring the amount and wealth of information that is hidden from our eyes by the barrier of language.

In his critical discussions it is difficult to say what we should admire more, his criticism of the results or of the research methods. Both are admirable, but we ought to be specially grateful for his critical treatment of the more important methods which are used in studying the various aspects of the water balance in plants. The author thought it necessary to deal with methods in considerable detail, as his book ' is intended to serve not only as a manual for investigators, but also as a work of reference on questions regarding water relations for plant physiologists and ecologists, as well as for workers at agricultural experiment stations '.

From his criticisms it becomes evident how difficult it is to devise physical apparatus or experiments by means of which we can somewhat satisfactorily imitate or even measure physical processes which are going on in the living plant. We refer only to his treatment of the various evaporimeters and atmometers where he comes to the conclusion that most of them are unsatisfactory for determining transpiration.

With regard to many questions the author holds his own views and these are often distinctly at variance with generally accepted opinions. His discussions of xerophytism and drought resistance form certainly the most interesting and stimulating part of his book. His opinions must call for re-examination of the foundations of many pet theories and hypotheses.

If it was the writer's intention to present in due perspective a picture of the many-sided relations of plants to water and to give a critical survey of the factors probably concerned in determining drought resistance, we must congratulate the author on what he has achieved by clearly and concisely putting before us the most intricate problems of the subject. How far his views in each case are correct, no amount of speculation will discover, the laboratory alone can give an answer.

E. B.

OBITUARY

OLDFIELD THOMAS

The death of Oldfield Thomas which occurred in tragic circumstances on June 16 last deprives the Society of a great friend. His work on behalf of the Society's Mammal Survey of India is well known to all members and the long series of papers describing the scientific results obtained by the Survey published in this *Journal* will always be regarded as forming one of the landmarks of Indian Zoology and a fitting memorial of their author.

Oldfield Thomas.

Thomas was a son of the late Rev. J. H. Thomas, Vicar of Hillingdon, Middlesex, and Archdeacon of Cape Town. He was born at Millbrook, Bedfordshire, on February 21, 1858, and christened Michael Rogers Oldfield. He disliked the first two names and (as he once confessed to the writer with humorous sadness) he spent a large part of his life vainly endeavouring to eliminate them with the lamentable result that he had to sign most legal documents twice instead of once. He developed a marked taste for Natural History in early childhood, and some two years' residence at the Cape as a small boy stimulated his interest to such a degree that he decided to become a Naturalist. He was educated at Haileybury and, on leaving school in 1876, he obtained a clerkship in the British Museum. During the two succeeding years he devoted his leisure to zoological studies under Huxley at the Royal College of Science where he soon showed conspicuous ability. In 1878 he was transferred from the office to the department of Zoology in the British Museum. In this department he at first acted for a short time as clerk to the Keeper, Dr. A. Günther, F.R.S.; later he was placed in charge of the collection of mammals, a position which he held until his official retirement on February 21, 1923. It is interesting to recall the fact that Thomas was by no means pleased with his appointment to the Mammal Room. At that time he was keenly interested in Echinoderms and thought he was going to take charge of them. But Günther was an autocrat and Thomas 'did' the Mammals.

Günther never made a wiser decision. He was himself greatly interested in mammals, and he thought that the keen, sharp-sighted boy would be just the person to help him to continue the solid contributions he was making to the systematic literature of the Mammalia. But the skirts of a great keeper's cloak were not ample enough to conceal for long the enthusiastic and ambitious Thomas. Günthur had intended to write the Museum Catalogue of Marsupialia and Monetremata himself; but Thomas made so many discoveries and worked with such energy and thoroughness that Günther willingly relinquished the task to him. In 1888 the Catalogue was published, and it remains to this day the solid foundation of all modern systematic work on the group.

Before 1890 mammal collections consisted chiefly of spirit specimens and of mounted skins stuffed with their skulls inside. The Biological Survey of the United States Department of Agriculture had just been established under the leadership of Dr. C. Hart Merriam, and the first reports of that Survey under the serial title 'North American Fauna' were just beginning to appear. Attracted by these reports, Thomas found that Merriam was working with long series of carefully prepared dried skins, each skin accompanied by its own cleaned skull, and labelled with full particulars as to locality, date of capture, sex, and flesh measurements. Correspondence followed and Thomas decided to give the new methods a trial. In the course of the next few years he perfected them. Leaving North America in the competent hands of the Americans, Thomas resolved that the British Museum should attempt a survey of the mammals of the rest of the world—a big task for one institution with very limited means and for one rather frail man to undertake.

In 1890 Thomas married Mary Kane, daughter of Sir Andrew Clark, the famous physician. This marriage brought Thomas considerable means, and his wife, much interested in Natural History herself and devoted to all that concerned her husband, readily agreed to the use of as much as could be spared from their joint purse for the purpose of financing collectors of mammals in various parts of the world. They went, too, on collecting trips together into various parts of Western Europe and to South America. Quickly Thomas gathered round him a band of volunteer workers in the Museum; and by hard work and perseverance he gained the ears and the purses of many wealthy people who were glad to benefit the national collections and advance the cause of Science.

One of the great secrets of Thomas's success in enlisting private help for his collecting schemes lay in the promptitude with which he worked out and published accounts of the material collected. Benefactors saw immediate results. Gifted with an extremely practical mind, Thomas was able to cut out all unessentials; in each problem that came to him for solution, he saw at once the point and the shortest way to it. He worked with amazing rapidity, jumping from one matter to another without hesitation or confusion of ideas, and he never forgot anything of real importance. A continuous stream of papers flowed from his pen in the *Annals and Magazine of Natural History* from 1880 down to the present year, with many contributions to the *Proceedings of the Zoological Society*, and in more recent years to this *Journal*.

In 1897 Thomas had the good fortune to become acquainted with that keen naturalist the late R. C. Wroughton, the Conservator of Forests in the Bombay Presidency. Wroughton had collected a number of bats in the Surat and Thana Districts; these were worked out by Thomas who described them in this *Journal* in 1897. Thomas urged Wroughton not only to continue collecting mammals but to work them out, and he gave his new friend every possible encouragement and assistance. Wroughton took up the new task with enthusiasm, publishing his first paper on 'Some Konkan Bats' in this *Journal* in 1899. These beginnings led to a close personal friendship between the two men. After his retirement from the Forest Service, Wroughton came to work in the Mammal Room at the Museum, and between 1905 and his death in 1921, he published as a result a very large number of papers on Indian and African Mammals in this and other *Journals*. As the work on Indian Mammals proceeded, it became evident that the material existing in the Museums was hopelessly insufficient to serve as a basis for satisfactory research. Wroughton, supported and advised by Thomas, urged the Society to undertake a Mammal Survey of India, and with the most active help of Mr. W. S. Millard and Mr. N. B. Kinnear, who together collected funds for and organized the Survey in India, the Mammal Survey was started in 1911, and produced the magnificent results with which all are familiar, and of which any Society or Government in the world might well be proud.

In all, Thomas described more than 2,000 species and defined more than 200 genera of mammals. His papers are models of terse description with nothing superfluous anywhere. Indeed, over and over again, he might have said a little more with advantage; but there was always another job waiting to be done, and he had said enough for the present purpose. Always busy and somewhat difficult to approach, people who knew him only by his scientific writings, regarded Thomas merely as a narrow systematist and a 'mere Museum naturalist'. No greater error was ever made; he was at heart a field naturalist, and on his various journeys made important collections of flies and myriopods in addition to his mammals. But, with a big task before him, he deliberately restrained his natural inclinations, saw clearly what he had to do, and lived just long enough to do it. His work has built the unrivalled National Collection of Mammals and the vast literature relating to it.

In order to accomplish his life's work, Thomas refused to entertain any thought of official promotion. Elected an F.R.S. in 1901, he served on the Council of the Royal Society, and for many years on the Council of the Zoological Society of London. After his official retirement from the Museum in 1923, he continued his old work as though nothing had happened. The death of his wife in May 1928 was a severe blow from which he never recovered.

The estate has been sworn for Probate at £42,613. The residue, which will probably amount to about £12,000, has been left in trust for the Trustees of the Godman Exploration Fund. The income to be known as the 'Oldfield Thomas Collecting Fund' is to be used by those Trustees in their absolute discretion for the benefit and increase of any of the Museum collections.

M. A. C. H.

MIGRATION OF WILD-FOWL

THE SOCIETY'S BIRD-RINGING SCHEME

Ring No.	Date of ringing	Species	Where ringed	Date of recovery	Locality
2992	30-1-29	Anas platyrhyncha...	♀ Kashgar ...	A few days later	A few miles from Kashgar, killed by trained falcons.
3005	1-2-29	,, ,, ...	♂ (Chinese Turkestan) ...	...	...
3373	23-1-29	Anas penelope ♀ ...	Manchar Lake, Sind 26° 40′ N. Lat. × 67° 60′ E long.	March 28, 1929	Near the river Syr Daria (Russian Turkestan) Lat. 45° 10′ N × long. 65° 15′ East. Shot after 64 days approx. 1,325 miles due N. Ringed by R. B. Machachlan. Recovery reported by D. Sviatsky, Scientific Secretary, Bureau of Regional Survey, Leningrad.

MISCELLANEOUS NOTES

I.—ALARM CALL OF LANGOORS

I see Mr. Champion, in vol. xxxiii, No. 2, p. 424, mentions langoors as being in his experience reliable in indicating presence of tiger and panther, and 'R.B.' in vol. xxxii, No. 4, mentions that in his experience they are not to be relied on to give their alarm call for carnivora only. I can add a further note on to this in my own experience.

They let me down most annoyingly once by not calling at all when a fine wounded panther must have (as shown by the blood tracks we found too late) passed right underneath a whole troop of them.

W. M. LOGAN-HOME,
Major, I.A.

JAMRUD, N.W.F.P.,
April 26, 1929.

II.—FOOD OF THE SLOW LORIS (*NYCTICEBUS COUCANG*)

I have had a Slow Loris (*Nycticebus coucang*) for a year and a few notes on it may be of interest. Though it usually sleeps rolled in a ball, in the middle of the hot weather, it stretches itself out along a branch, with arms and legs extended and hanging down. I have never seen it spring at its food, the final jerk to seize an insect may be likened to a spring, but it never leaves go of a branch entirely. It ate almost any insect, biting their heads off first almost invariably. One evening, I caught a bat, a *Scotophilus*, I think, and put it into the cage. This was quickly caught and partly eaten—again starting at the head. Otherwise the food given has been almost entirely plantains and a few other fruits and rice. I have only seen it drinking once. A very usual method of eating is to clasp a branch with the legs and hang head downwards and hold the food in the hands. He will feed for ten minutes at a stretch in this position, the head being turned back over the body a full 180° to face exactly backwards.*

TOUNGOO, BURMA,
May 11, 1929.

J. M. D. MACKENZIE.

[A Slow Loris which we kept in captivity lived on practically the same diet—insects (grasshoppers) and fruit. He was however a great tea drinker and immensely enjoyed a saucer of tea we gave him every evening.—EDS.]

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* See also Misc. Note No. XXVII. on p. 1000.

III.—TIGER TRACKS

Mr. F. W. Champion in his article (*Journ. Bomb. Nat. Hist. Soc.*, vol. xxxiii, No. 2) raises some interesting points on the Tiger's action and as he specially invites the views of others, I venture to express mine. In my opinion, the normal action of a tiger walking is exactly as Mr. Champion describes. The two legs on one side are in motion together, and then on the other, alternately. The hind-foot oversteps the position vacated by the fore-foot. If the tiger is striding along, the clear space between the two pug marks is 6″. I am taking Mr. Champion's maximum figures—I have never myself actually measured the distance, but from recollection I should say it often exceeded this. If the tiger progresses more slowly, or with purposeful caution, the gap decreases, and in following up pug marks along a *nala* one comes on places where the tiger has been obviously 'interested' or has rounded a corner with great caution. In these circumstances one comes on places where the hind-leg *on the same side* has been placed exactly over the spot vacated by the fore-foot. Of course this action reduces both speed and noise. It is possible that a tiger, hungry and hunting, might continue this action over some distance, but it is not the tiger's care-free, habitual action, it is controlled and purposeful action. A wounded or sick tiger will often not step out, and the pug marks cut each other: this is however an artificial action due to abnormal conditions. Both legs on the same side are frequently off the ground at the same time, and it is quite possible to follow this with the naked eye: Mr. Champion's photograph is of course irrefutable evidence that this is so. No tiger that I have seen has crossed its legs while walking or in motion, nor have I ever seen a pug mark that in any way suggested that this had happened. The fallacy that an animal 'must have at least one leg on the ground simultaneously on either side to preserve its balance' can be disproved most easily perhaps by placing oneself prone, resting on the right hand and right toe. The only occasion on which I recollect having seen a tiger's hind-leg on one side placed adjacent to the fore-foot of the opposite side has been when the tiger was stationary, crouched and prepared to spring. Mr. Champion has attached perhaps too much importance to the 'dicta' of Mr. Hicks, whose opinions on the natural history of the game he hunted have never carried much weight amongst those capable of verifying them.

IVY BANK, ELGIN,
SCOTLAND.
April 17, 1929.

A. A. DUNBAR BRANDER.

IV.—PROPORTION OF THE SEXES IN TIGERS

Out of 16 tigers accounted for in this District in the last few years 10 were tigresses and 6 were male tigers. It would be interesting to learn whether the proportion of males to females shot, of tiger, in other Districts is similar.

HONNAMETTI ESTATE, ATTIKAN P. O.,
Via MYSORE.
April 5, 1929.

R. C. MORRIS.

V.—ON THE OCCURRENCE OF TIGERS ON THE ISLANDS OF BOMBAY AND SALSETTE

A large tiger was shot in the vicinity of the Vehar Lake, Salsette on Tuesday, January 22, 1929. The animal was killed by Mr. J. J. Sutari, to whom I am indebted for the following particulars. Mr. Sutari and a party of friends were out after the usual type of game the Salsette jungles provide, which is mainly wild boar. They took up their positions in the vicinity of the south end of the lake shortly after sunset and waited for something to turn up. Towards 10 p. m. Mr. Sutari's attention was aroused by the sounds of some animal approaching. One can well imagine his astonishment when a tiger walked out of the shadows into the moonlight. The tiger came steadily on, when at a distance of 12 yards, Sutari fired his 12-bore loaded with ball and dropped the animal in his tracks. The tiger in question, a straggler from the main land, probably crossed over by swimming the Thana Creek. An animal doing so would find immediate shelter in the jungles which cover the hilly portions of Salsette.

Tigers appear to have been fairly plentiful in Salsette at the end of the eighteenth century. Hector MacNeil, (*Archælogia*, vol. vii, 1873) tells us that in 1761 ' the Governor and most of the gentlemen of Bombay used to go annually on a pleasure party to Salsette to hunt Wild Boar and Royal Tiger both of which were found there in great plenty.' Records of the occurrence of tiger in these islands during the nineteenth century are few and far between. In 1806, two tigers were seen near General Macpherson's bungalow at Kurla, while a few days previously two persons were carried oft from a village a little further north, it is presumed by the same animals. On February 9, 1822, a tiger on Malabar Hill came down and quenched its thirst at Gowalia Tank and ran off up the hill between the Hermitage and Prospect Lodge. The imprint of its feet were clearly visible the next morning (*Bombay Courrier*, February 10, 1822). The *Bombay Courrier* of December, 1829, records the sudden appearance of a tiger at Mazagon, the animal apparently swam across the harbour and landed near the ruined Mazagon fort. It was driven into the compound of Mr. Henshaw's bungalow where it was eventually shot by the guard of the Dockyard and several Arabs. It measured 8′ 8″. On March 2, 1858, the crew of the steamer *Aden* killed a large tiger which was swimming across to Mazagon from the opposite shore. The animal attempted to board a small boat and was kept off with hand pikes by the lascars. It was eventually dispatched with ' six balls through its head'. (*Bombay Times*, March 6, 1858). In May of the same year a tiger was killed in Mahim woods by a young Portuguese, while on January 26, 1863, another tiger was killed at Mahim after mauling a Parsi cart-owner and committing other damage. (*Bombay Times*, January 27, 1863). James Douglas (*Bombay and Western India*) writing about tigers in Salsette gives an amusing narrative of a ' traveller (was it Silk Buckingham ?) in Salsette who was suddenly surprised by his palkee being dropped and the coolies bolting. The palkee was closed, and he soon felt outside the *Jhilmils* something of a fee-faw-fum character. Stripes was wide awake and the coolies, up a tree, were wide awake also. He didn't sleep much that night I tell you.' In 1907, a tiger was shot at Pir Pau, Trombay, near Sandow Castle by Mr. Mullan of the Bombay Port Trust. This with the one cited above are the most recent records.

Bombay Natural History
Society,
June 22, 1929.

S. H. PRATER, C.M.Z.S.

VI.—THE TIGER'S METHOD OF MAKING A 'KILL'

(*With a photo*)

I had the good fortune this year to witness, by the light of the moon nearly at the full, the killing of a tethered buffalo by a tigress.

The near approach of the tigress was made known to me at 10 o'clock by the sudden uprising of the buffalo from his quiet chewing of the cud. He stared into the forest. Then the tread of the tigress—who had given up all concealment as she knew her prey could not now escape her—was heard among the leaves. The head of the great feline came into the field of view of the binoculars, her fine ruff—for she possessed an unusually large one—shining conspicuously in the brilliant rays of the moon. I could see every whisker and hair on her face.

Slowly the whole of her lithe but massive form came into view, advancing by short steps, with every muscle taut and alert for instant action. The tethered bait, which had up to now remained motionless, staring at the dread apparition, made a sudden effort to break loose. That was the signal which launched the tigress to the attack. There was a short scuffle, a choked bellow, and then absolute silence as the tigress stood, the back of the buffalo's neck in the vise of her jaws. All but her head was in the shadow of the tree, but I could make out that she was straddled across the body of the buffalo. What she did with her paws could not be made out, there was no apparent movement but presently I heard the crack, and the crack, of the breaking of the vertebræ of the victim's neck.

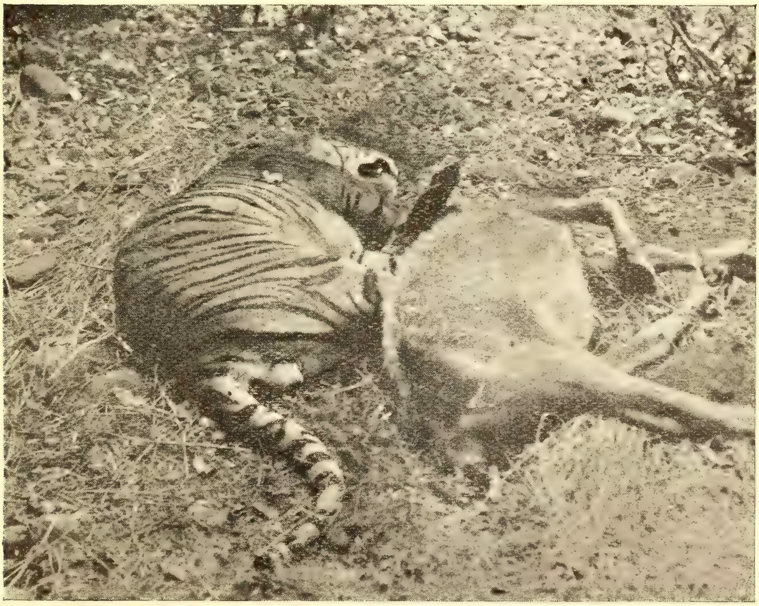
Now, the killing finished, the tigress opened her jaws and the lifeless body of the victim fell with a helpless flop on to the ground. A few moments she stood, wholly alert to her surroundings and gazing this way and that. Then she seized the body by the hindquarters to drag it away ; after several tremendous tugs she gave up the attempt and, squatting at the tail end of the carcass, now stretched to the full length of the wire tethering rope, commenced to tear it open. This took but a second or two, and with great gulps she began the hot meal she had so easily obtained.

In ten minutes she suddenly got up and went straight off into the forest behind her. She appeared drunk with her success, or the rich wine with her dinner, for she made no attempt at quiet progress, barging through the jungle with a crashing of undergrowth and leaves. All sorts of noises she made; gruntings, belchings, and noises difficult to describe. The sound of her noisy progress died away and all was again quiet, the absolute stillness of the tropic night in the forest. There had been at no time—not even before her approach to the buffalo—any indication on the part of the numerous denizens of the jungle that the tigress was on the move; and there was a similar silence on her departure.

It was six hours before she returned, which she did in absolute silence and without any forest warnings. Down she sat and recommenced her meal. I turned on the distant light which was directly over her head. Of this she took no notice; but when, her exact position clearly ascertained, the torch fixed on the rifle was flashed in her face she lifted her head, her eyes shining like emerald lamps. Next moment she was dead; and the loud sigh of the breath leaving her body came to my ears in the stillness of the night as the reverberations of the rifle shot died away in the distance.

A few weeks later a tiger met instantaneous death in the act of killing a tethered bait. There was no moon; he was a most wary and cunning beast, and to have put on the distant light when the scuffle began might have scared him away. I could take no chances. The torch showed him standing by the side of the '*boda*' with the back of its neck in his jaws. He was facing away from me.

To the shot he fell on his side; and so instantaneous was his death that the claws of his left forepaw remained hooked into the right cheek of the buffalo, and the victim's hind legs were kicking in the death struggle after the tail of the slayer had ceased to beat



THE TIGER AND ITS KILL

the ground. Only his jaws had quitted their hold, and I saw them open and close in convulsive gasps.

All four legs of the tiger were underneath the body of the buffalo as it fell, as can be seen in the photograph taken early in the morning. In this case the tiger had not straddled his legs over the kill, but stood by its side, his hind legs well under him. He was slain before he had time to break the neck of his victim.

To have attempted to beat out this tiger would have been useless. It could not be known where he would lie up, and the villagers were a timid crowd. Two of my *bodas* this tiger had killed with impunity; so I was determined he should not escape. It was on the eighth night in the machan that I slew him. That he would return along that path in the river bed was certain; and it is just as comfortable, and far more interesting, to sleep in a large machan bed as in one's camp!

R. W. BURTON,
Lieut.-Colonel,
Indian Army
(*Retired.*)

COONOOR,
June 1, 1929.

VII.—AN EXPERIENCE WITH A TIGRESS

The following experience with a tigress may interest the readers of your Journal:

We were shooting in the Central Provinces. As no beaters were obtainable, we spent mornings and evenings in silently stalking along the game paths that crossed the jungle in every direction. One afternoon about 4 o'clock we started with our shikaris as usual, going in Indian file along a small path flanked by high grass and scattered bushes. After proceeding for some distance, we heard a low humming sound in front which brought our party to a stop. The lady member of the party told us afterwards that she took the sound as coming from a swarm of bees which abounded in the jungle. This, however, was a momentary illusion as the sound quickly gathered volume and, with a loud roar, a tigress charged out of the grass and came down the path in our direction. At a distance of some 12 or 15 yards she suddenly checked her rush, stopped dead for a moment slightly sideways and evidently with the intention of turning away. This was the opportunity for placing a shot and the next instant, with a bound, she disappeared in the grass again, leaving us standing on the path surprised and wondering whether we had seen the last of her.

As nothing further happened, we wisely decided to put off further investigations till the next day when we found the tigress dead some little distance away. We also discovered the reason for her aggressive behaviour. In a bush near by we found the remains of a sambhar which she must have killed the night before. She was lying up near it with the intention of having another meal and resenting our interference, she tried to scare us away. In other words, the old lady was merely bluffing, she did not mean to charge at all.

It was probably the same tigress which a few days earlier was said to have stopped the transport of forest produce at a place some miles away by lying up near the cart track and frightening man and bullock by flying at anything that came her way but never doing any damage.

BOMBAY,
April 24, 1929.

S. HANHART.

VIII.—SENSE OF SMELL IN THE LION.

I have just been reading your Volume xxxiii, No. 2, with great delight, especially the account of the Sal Forests and the Gonds with whom I have had many a happy day long years ago.

With reference to the sense of smell in the larger carnivores, I was lying on the ground once in Somaliland close to a lion's kill, shielded from a dual view to some extent by a thin zareba of thorns hastily put together about three feet high. A lion came down to the kill in full daylight and stood looking at it about 25 yards off. I was just going to rise to a sitting position when I heard a deep breath just above my head and saw the yellow side of another lion not 6 feet from me approaching from my rear. This lion came and lay down at the kill not 3 feet from my own feet. I could not see if it was a lion or a lioness. I knew the first one was a lion—so I raised myself up very quietly and fired at No. 1 over the back of No. 2. I killed No. 1 and No. 2 dashed off but came back later when it was quite dark and I killed it also; both of these were lions. But their sense of smell must have been very deficient.

Perhaps you will think the above worth putting in your Miscellaneous Notes. It may also interest you to feel how we old Anglo-Indians appreciate your efforts. I was one of the very early members of the Society—and with Phipson—' Eha '—Newnham—G. Anderson used to go out pig hunting *circa* 1885-1886—as far as I know, Phipson who lives within 12 miles of me and I are the only ones of the party left.

SHAPLEY HILL,
WINCHFIELD,
BASINGSTOKE.
May, 1929.

HARRY D. OLIVIER,
Colonel.

IX.—WOUNDED PANTHER RETURNING TO 'KILL'.

In regard to my note dated June 7, 1928, *re:* wounded tiger returning to kills, a case recently occurred in these parts of a panther receiving a mortal wound and yet returning to its kill without, however, feeding. The present Forest Range Officer of Kollegal, Mr. A. R. Nair, was sitting up for panther over a live bait (goat), and was rewarded by seeing a fine panther jump out of the surrounding bushes and leap on the goat. He fired and the panther dashed off. He was very surprised, as he felt certain that he had scored a hit, when he saw the panther half a minute later again approach the kill. The panther was obviously uneasy, and having looked all round, turned quickly again into the scrub without actually touching the kill, and a few seconds later commenced to groan. After a further wait, Mr. Nair got down from the tree, and as he discovered that the bullet had entered the ground and there were no traces of blood, he concluded that the panther had been missed. The following morning search revealed the panther lying dead within a chain of the machan, with a bullet wound right through its stomach. Mr. Nair was using a 12-bore gun with spherical ball, and the bullet had passed clean through the animal. Whether the panther had, after being hit, returned to attack his antagonist, or had not realized for some moments what had happened to it cannot of course be known, but I am inclined to the view that the latter was the case. Mr. Nair realized, when he found the animal dead, that he had done a dangerous thing in descending from the machan with the panther lying up so close. He informed me that the panther measured 6′ 10″.

HONNAMETTI ESTATE,
ATTIKAN P. O.,
VIA MYSORE,
April 1, 1929.

R. C. MORRIS.

X.—PANTHER CLIMBING UP TO A MACHAN.

It is not often, when sitting up over a kill, that one has a panther ascend to one's machan, so an experience of this occurrence will be of interest.

The incident took place in the same tree from which Captain Graham of the Rifle Brigade shot a wary tigress over a live *boda* in 1927 (*Journ. B. N. H. S.*, vol. xxxii, p. 587).

The tethered buffalo calf was killed by a large male panther. In the evening he made his approach known by much grunting. I saw him come out of the bamboo jungle on to the cart road at side of which was the kill, lying at the foot of a tree ten yards away from the machan tree. As he stepped into the open, he looked up the river bed and evidently sighted an intruder, as he returned into cover. Then there was much panther talk, and I realized—as I suspected must be the case, for panthers when alone never demonstrate in this way, that he had a companion ; indeed he had two of his female relations with him. All sorts of noises went on ; gruntings, rushes through the bamboos, and frolics galore.

None of the animals showed up at the kill, and it was nearly dark when there was a thud at the foot of the trunk of my tree, which shook at the impact, another thud against the other trunk of the same tree, and in a moment of time after the first thud I saw the bullet head of a panther as it lay crouched on a bough, five feet above and to the left of my head, and looking down at me.

A bullet from the ·470 blew it off its perch on to the ground below the machan. A female, full grown, old (as could be seen by the teeth and the almost invisible sutures of the skull), weight 70 lbs. The other female came later to the kill and was missed; next evening I shot the male.

Investigation next morning showed that in her frolics she had climbed into the tree above the kill perhaps to escape the too pressing attentions of her male companion and from there she must have seen some movement of mine in the machan. So down she came to investigate, possibly thinking there was a lungoor in the tree. The machan was absolutely screened on all sides, and from below, by green branches.

The lightning rapidity with which she ascended the tree to height of over 20 feet; the certainty with which she selected the only branch suitable to her purpose; and the ease with which she crouched on that, a bough not more than 4″ in diameter, was most astonishing.

I have heard panthers hunting lungoors in trees on a moonlight night, and can now more readily realize how frequently these animals must fall victims to their hereditary foe.

The incident here related took place in March, 1928.

I have spent many nights in a machan but only in last March did I hear the peculiar noise made by a porcupine during his nightly wanderings.

It was a loud in-taking and expulsion of breath, such as one can make through one's nostrils. I was sitting up over a kill, and the cart track was dusty and quite clear of tracks because it had been swept with branches; so there was no doubt as to what animal had made the noise which had puzzled me during the silent watches of the night.

Coonoor, R. W. BURTON,
June 1, 1929. *Lieut.-Colonel, Indian Army* (*Retired*).

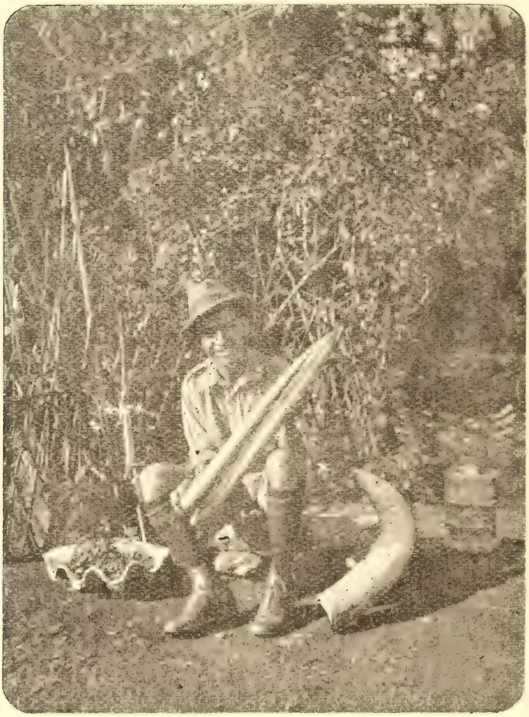
XI.—ROGUE ELEPHANTS WITH MALFORMED TUSKS.

(*With a photo*).

The people inhabiting the jungly tract at the northern part of the Khasi Hills, known as Bhois, mainly depend upon rice cultivation for their existence. This they generally cultivate by the system known as 'Jhum cultivation,' i.e., burning a patch of jungle and then sowing paddy. They also cultivate other side lines, such as pumpkins, chillies, cotton, Indian corn, etc., but their chief and in fact their only cereal is rice.

These tracts are frequented by large numbers of wild animals of all sorts and as they include such destructive creatures, as wild pigs, deer, sambhar, and finally wild elephants, the cultivators frequently suffer great losses from their ravages.

The smaller creatures such as pigs, deer, etc., can be frightened off by various stratagems and even a herd of elephants may be made to leave early by means of fires, torches, etc., but when a solitary wild male elephant visits such cultivations, then the matter assumes quite another aspect. Not only will such an animal take no notice of all attempts to drive him away but he will frequently chase the people about and any one caught by him meets with a sure death.



MALFORMED TUSKS OF ROGUE ELEPHANT

During the course of my tours as a member of the Agricultural Department of the District, I frequently came across the depredations committed by the rogue elephants and was fortunate enough to bag some of them on various occasions. So far as I was aware, male elephants consisted of tuskers and non-tuskers or *Muknas*, there being many types of tusks amongst the former class, but recently I shot a rogue tusker, which had most peculiar tusks (vide photo). One of the tusks (the right) was short and straight with a fleshy exuberant along the length of the tusk, as would be seen from the photo and quite unlike any other tusks I have seen. Apparently this tusk is in the nature of a freak as it did not appear to have been broken off.

This beast was roaming about in the neighbourhood of a village named Mathan in the Mylliem State and was easily polished off by a temple shot from my Vicker's ·404 magazine rifle.

SHILLONG, L. L. READE.
May, 1929.

XII.—NOTES ON BERDMORE'S SQUIRREL (*MENETES BERDMOREI*)

Blanford (*Fauna of British India*) does not contain much information about the habits of *Menetes* (*Sciurus*) *berdmorei*, of which there are several specimens in the collection I have sent to be worked out. It is chiefly a ground squirrel, but does ascend small trees occasionally, and creeps about in bamboo clumps and rubbish—habits rather like a *Tupaia.* It is not common here, and most of my specimens come from near cultivation; two have however come from hill jungle containing secondary growth from cultivation. It extends up to 4,500 ft. here.

On May 7, 1929, my man found a nest containing two young ones, apparently a fortnight or three weeks old. I have kept them alive, and they take milk, and fruit to eat. Their movements are sharp and jerky, or else very slow, like other small squirrels I have had, and they shew the same desire to creep into crevices in one's clothing.

The nest was situated in a hole in a bank, and made of bamboo leaves, moss, grass and fibre.

TOUNGOO, BURMA, J. M. D. MACKENZIE.
May 11, 1929.

XIII.—ELEPHANT MISTAKEN FOR A TIGER!

A strange Shikar episode

The following is one of the strangest episodes in shikar I have ever been connected with and an accident which, previous to the happening, I would have thought fairly impossible to occur. R. E. W. was out after tiger at Bailur, and two *kills* having occurred the same day he sat up over one of them with, however, no success. The tiger did not return. On the following day I joined him at Bailur and having decided to sit up over the second kill together, we were comfortably seated on the machan by 5 p.m. The tiger by the way had not returned the previous night to this kill either. At about 6 a howling gale sprung up. The machan was built partly on bamboos and partly on a semi-decayed old fig tree and we had considerable misgivings as to whether it would hold together with the strain imposed upon it in the heavy wind. We decided, however, to stick it out till midnight if possible. At 10·30 the wind was so bad that we decided to get down half an hour later if the tiger had not by then put in an appearance. R. E. W. felt very sleepy, having sat up the previous night, and asked me to keep watch while he dosed for the remaining half hour. At 10·45 I heard a loud crack at the kill and woke him up. We listened and again heard a crack, this time well to the left of the kill. I whispered that the tiger had come and had evidently dragged the kill, breaking the rope, off to the left. We then heard what we took to be a dragging noise across our front and then towards us through the bamboos, and finally under the machan with frequent pauses, and then there was a sudden jar and the machan shook violently. Whispering to R. E. W. that the kill had evidently been caught in the bamboos for a moment and that the tiger had tugged it free, I suggested the advisability of our kneeling and facing the rear of our machan as the noise was definitely behind us. This done, R. E. W. decided to switch on his torch as it was his last chance of seeing the tiger. At first nothing could be seen through the foliage all round and below us and then R. E. W. said he could see something long and brown moving up a slope and that he was sure it was the tiger's back. He fired and for a moment there was complete silence, followed by a groan and a thud. We were convinced that he had laid the tiger low with one shot, and I was in the middle of congratulating him when we heard a hard knock, like horn on stone, which puzzled me considerably and, turning on my torch, I searched about and to my horror saw the tips of a pair of tusks! I could hardly believe my eyes and, dumbfounded, said to R. E. W. 'Good heavens, it is an elephant;' to which he replied 'Rubbish!' He, however, brought his light to bear on the spot on which mine was directed and we could both then see the tusks and trunk of a half grown elephant. We were aghast—the inconceivable had happened—we had committed the offence of shooting an unproscribed tusker without even the excuse of self-defence! The elephant was obviously unable to rise, but apart from that was very much alive. We could not see where R. E. W.'s shot had hit it, and presumed it to have been on the knee. We adjudged the elephant to be about 6 ft. in height, a '*butcha*' in fact with extraordinary tusks for its age (the tusks turned out to be 4 ft. in length when extracted later). The tips of its tusks were only about 6 ft. from our rope ladder and as I attempted to get down it lashed out with its trunk upon which I ascended hurriedly again! There was a possibility that the elephant was only temporarily disabled, and that it would, if left, manage to get up and go off. We waited for an hour and as the elephant's efforts to rise were still ineffectual, we decided to get down from the machan jumping clear of the elephant when near the bottom of the ladder. I got down first descending cautiously and leapt to the ground well out of the elephant's reach, while R. E. W. covered the elephant with his rifle. He then let down both our rifles and soon joined me, I having covered the elephant during his descent. We found the bottom rung of the ladder broken and it was evident that the elephant had pulled it when under the machan, and this had caused the machan to shake as it did. Safely down, we shone our torches on the elephant and found that its forelegs were anyhow not disabled, nor could we see any wound on its head or body. There was, therefore, still a faint chance that the elephant would be able to recover his legs and make off little the worse, and devoutly praying that this would be the case, we left the unhappy scene of action and found our way back to the shikar huts where our Sholaga shikaries were putting up for the night. On hearing our story they were intensely amused and declared that we had mistaken the elephant for some other animal! as there was no elephant in the vicinity, no tracks had been seen of any elephant for three months, and there was no way for an elephant to approach the place except through a valley near by which was crowded with cattle and cattle-pens. On receiving our assurances, however, that there was no mistake about it they became very glum and it was a silent party that made its way back then, well after midnight, to the Bailur Bungalow. There was just one thing we had to congratulate ourselves over: it was very fortunate for us that the elephant had made its presence known when it did ; had it come along a quarter of an hour or twenty minutes later, after we had got down from the machan, we might have walked straight into it with disastrous results. Early on the following morning we got hold of the local Forester and took him with us to the spot. The elephant was still literally alive and kicking, and we wanted to finish him off, but the Forester implored us to obtain the D. F. O's permission first. The Forester evidently thought that it would be hard to get Government to believe it possible for an elephant to be mistaken for a tiger, even though at night, and naively said, ' Why not say the elephant came and attacked the machan and you fired to save your lives, Sir?'!! This certainly would seem to be a more plausible yarn, but we decided that it was always best to stick to the truth. There is no doubt that the high wind, coupled with the fact that the elephant was a young one and had to push and push his way through the bamboos and thick undergrowth, had helped us to believe, without a shadow of a doubt, that the tiger was dragging the kill.

We covered a large part of the Kollegal Taluk in our car looking for the D. F. O. and discovered finally that he was on tour on the Baragurs ; and as we were short of petrol and it was then too late to follow him further, we decided to take on ourselves the responsibility of finishing the elephant off and this we did. Altogether a remarkable chain of ill-luck had led to the elephant's final destruction : firstly, if R. E. W. had sat up over this kill on the first night instead of over the other, he would not have seen the elephant. Secondly, it was most extraordinary that the elephant should have approached the kill and broken a bamboo actually at the kill, which was the first noise I heard. Up to then the roaring gale had covered the noise of its approach. Lastly, it is strange that its next movements should have taken it right under our machan. If it had not stopped behind our machan R. E. W. would certainly not have had time to fire at it. The poor little brute's death was most premature : if it had lived it would undoubtedly have grown into a very fine tusker, but, as the Forester remarked on viewing the elephant, ' this animal was undoubtedly fated to die young, and moreover to come here to die ' !

HONNAMETTI ESTATE,
ATTIKAN P. O.,
Via MYSORE,
June 15, 1929.

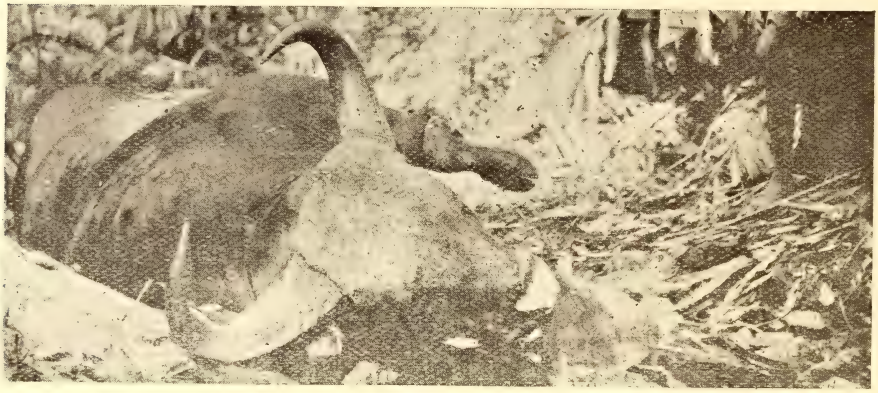
RANDOLPH C. MORRIS.

XIV.—BODY MEASUREMENTS OF A GAUR (*BIBOS GAURUS*)

(*With a photo*)

On a short visit to Travancore in April this year I was fortunate enough to bag a bull ' bison ' ; an animal, which, for many years, I have been anxious to secure.

The bull was a youngish beast in his prime, as can be seen from the accompanying photo which shows his head fairly clearly, He was almost jet black on his fore-quarters but very dark chocolate further back on the body.



BULL GAUR (*Bibos gaurus*)

The appended list of measurements—which I took with a steel tape, with the assistance of my host, Mr. C. P. Gouldsbury of Guderale Estate, Mattupatti P. O.—may be of interest to your readers, as the shoulder height is very much below that usually given for a bull of this species.

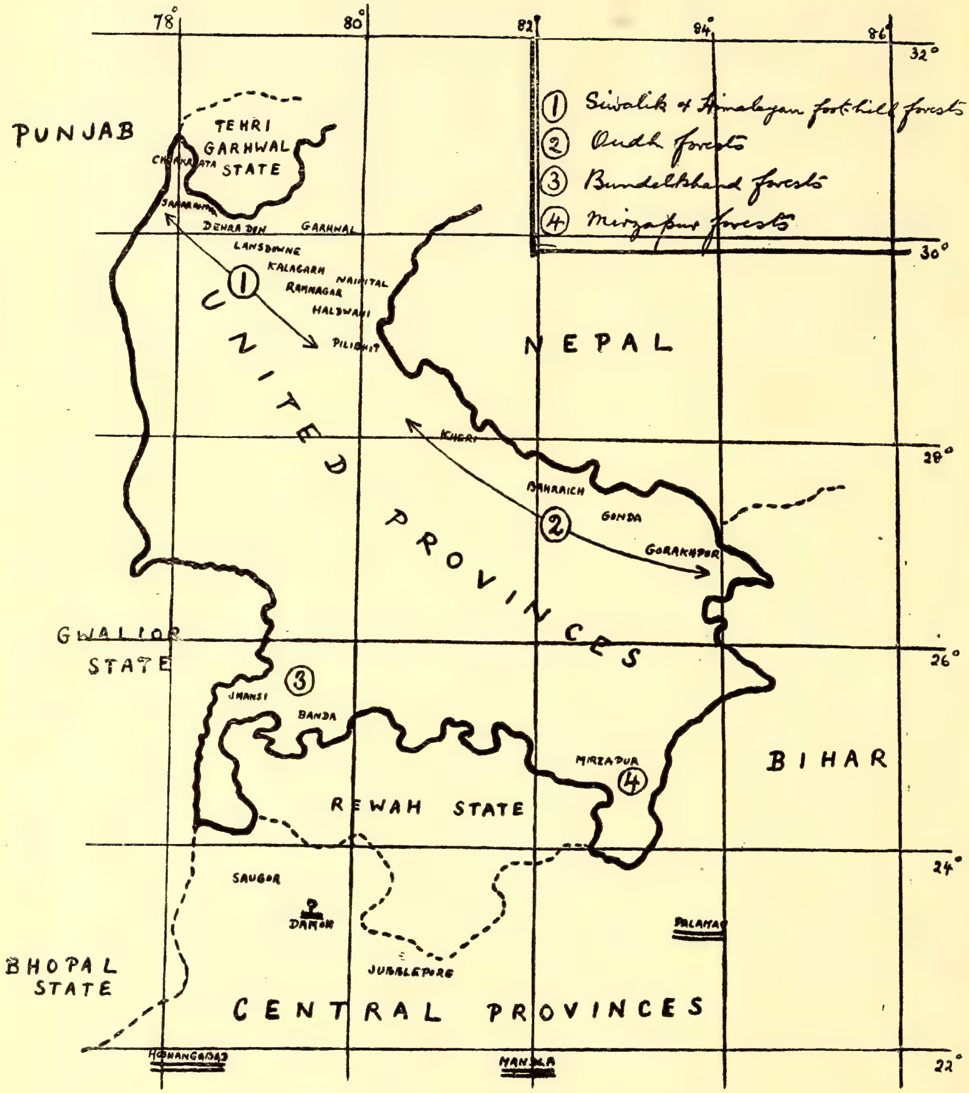
The ascertainment of body measurements of Ceylon game animals has been a hobby of mine for many years ; and I may state that I have found my trophies almost invariably to tape less at the shoulder than the measurements given in the few books dealing with this subject in respect of Ceylon fauna. As regards Ceylon sambur and spotted deer, stags for example, I have found 48 in. and 31 in. respectively to be about the maximum shoulder height—measurements taken after death with fore-leg held as nearly as I could judge in the natural standing position.

To return to my bison, however, it will be realized that stretching or depression of the fore-leg muscles of a beast of this species is only possible for an inch or two ; and as I was using a 5 ft. steel tape—which proved more than long enough for this measurement—I can guarantee the accuracy of my figures. I mention this fact as I have been told since then that I '*must* have made a mistake' that the bull '*must* have been a dwarf', etc. !

I give a full list of measurements which I took, as they may prove of assistance to others, who have had experience of this beast, in judging the general size of the animal.

I shall be very interested to have any comments thereon, more particularly as to the shoulder height.

(1)	Horns, sweep ...	... 75½ ins.
(2)	,, length, right horn	... 29½ ,,
(3)	,, ,, left ,,	... 29¾ ,,
(4)	,, widest outside	... 35⅛ ,,
(5)	,, ,, inside ...	... 29⅛ ,,
(6)	,, tip to tip ...	... 16⅞ ,,


78°
80°
82°
84°
86°
32°
30°
28°
26°
24°
22°
① Siwalik & Himalayan foot-hill forests
② Oudh forests
③ Bundelkhand forests
④ Mirzapur forests
PUNJAB
TEHRI GARHWAL STATE
CHAKRATA
SAHARANPUR
DEHRA DUN
GARHWAL
LANSDOWNE
KALAGARH
NAINITAL
RAMNAGAR
HALDWANI
PILIBHIT
①
UNITED PROVINCES
NEPAL
KHERI
BAHRAICH
GONDA
②
GORAKHPUR
GWALIOR STATE
③
JHANSI
BANDA
MIRZAPUR
④
BIHAR
REWAH STATE
SAUGOR
DAMOH
PALAMAU
JUBBLEPORE
BHOPAL STATE
CENTRAL PROVINCES
HOSHANGABAD
MANDLA

Sketch of the United Provinces & neighbouring country showing forest-areas. Forests definitely known to hold mouse-deer are marked thus :- ═══

DISTRIBUTION OF MOUSE DEER

(7)	Horns, girth, right horn ...	$19\frac{1}{12}$ ins.
(8)	,, ,, left ,, ...	20 ,,
(9)	Length of head and body ...	8 ft. 2 ins.
(10)	,, tail (including 5 inches tuft)	2 ,, 11 ,,
(11)	Height at shoulder	4 ,, 9 ,,
(12)	,, of body only at shoulder ...	3 ,, $7\frac{1}{2}$,,
(13)	Girth behind shoulder ...	9 ,, 11 ,,
(14)	Girth of neck, 1 ft. from horns ...	5 ,, 5 ,,
(15)	,, 2 ,, ...	7 ,, 0 ,,
(16)	,, round centre of face ...	2 ,, 7 ,,
(17)	Length of ear	9 ,,
(18)	Length of hind foot (to hock) ...	1 ,, 10 ,,
(19)	,, ,, (hoof) ...	$4\frac{1}{2}$,,
(20)	,, fore foot (hoof) ...	$5\frac{1}{2}$,,
(21)	Circumference round fore foot (hoof)	1 ,, 5 ,,
(22)	Circumference round hind foot (hoof)	1 ,, 3 ,,
(23)	Circumference round shin ...	$9\frac{1}{2}$,,

Measurements of length and height were taken in a straight line or between uprights. This bull had, practically speaking, no dewlap.

RONDURA GROUP,
GINIGATHENA,
CEYLON,
May 20, 1929.

I. L. CAMERON.

XV.—THE DISTRIBUTION OF THE MOUSE-DEER (*MOSCHIOLA MEMINNA*)

(*With a map*)

The records of the occurrence of the Mouse Deer (*Moschiola meminna*) in Upper India are so vague and contradictory that I have made an effort to arrive at a more accurate knowledge of their distribution.

Hodgson includes this animal in his list of Nepal mammals, and Blyth refers to a Nepalese specimen in his catalogue ; but these notes have never since been confirmed, and, as a result of my present investigation, appear to be inaccurate. I can obtain no authentic record of a single specimen ever having been obtained anywhere in the United Provinces, and it seems very unlikely that there should be such a big gap in their distribution as that between the north of the Central Provinces and Nepal.

Lt.-Col. Stockley in his recent book *Big Game Shooting in the Indian Empire* states on page 19, ‘A morning walk in the Siwaliks may produce anything from a tiger to a mouse deer.’ The Siwaliks are the outer range of low hills which form the boundary between the great Himalayan Range and the Gangetic Plain of the United Provinces. I have lived in the forests of this tract for many years and I am in intimate touch with other Forest Officers. I have also access to the Forest Records of animals which have been shot for many years past, and I am in a position to make the definite statement that no mouse deer has been recorded as shot for many years by anyone, and no Forest Officer—and Forest Officers live in their jungles for the greater part of the year—believes that mouse-deer exist in the Siwaliks. I therefore conclude that this statement by Col. Stockley must be a slip of the pen.

Again the same author in the same book, page 165, gives the distribution of mouse deer as 'Peninsular India as far north as Khandesh, southern United Provinces, and Orissa.' Firstly, it is to be noted that the Siwaliks are in the northern United Provinces and are not mentioned here, so that Col. Stockley's statements on pages 165 and 19 do not agree. Then as regards the southern United Provinces. The forests in the south of the United Provinces occur in the south-west near Jhansi and Banda (Bandelkhand) and in the south-east at Mirazapur. With regard to Bandelkhand, the two Forest Officers in the United Provinces (Messrs. Whitehead and Benskin, both now Conservators) with the greatest experience of Bandelkhand—an experience extending over many years—assure me that mouse deer are quite unknown there. The jungle tribes have no name for them, and there are no records of any having been shot in the whole of Bandelkhand. As regards the Mirzapur forests, there was a suspicion that the species might occur in the Dudhi forests at the very south of the Province, so I asked Mr. Bhattia, the Divisional Forest Officer of Mirzapur, to make a thorough enquiry for me. This he very kindly did, with the result that mouse deer are reported not to occur anywhere in Mirzapur District, and to be quite unknown to the jungle tribes living there.

In these circumstances, there appears to be considerable doubt as to the existence of mouse deer anywhere in the United Provinces, and I would ask Col. Stockley to publish his evidence for stating that they do occur there.

As regards areas adjacent to the United Provinces, the Political Agents of Rewah State, Gwalior, and Bhopal are of the opinion that the species does not occur in their respective states. The most northerly places where the animal is definitely known to occur are the Mandla and Hoshangabad forests of the Central Provinces and Palamau in Bihar, all of which are south of latitude 24°. I therefore arrive at the conclusion that 24° latitude is approximately the northern limit of this species, and I would ask all readers of the *Journal* who may be interested in the subject to send in any records they may have which may confirm or contradict this conclusion. I add a rough sketch map of the United Provinces and environs to make the position clearer.

In conclusion I would like to take this opportunity of thanking all the Political Agents and Forest Officers who have so kindly supplied me with material for this investigation.

LANSDOWNE,
April 21, 1929.

F. W. CHAMPION,
Indian Forest Service.

XVI.—HOW THE FEMALE DUGONG CARRIES HER YOUNG

In my paper on the Dugong (*Journ. Bom. Nat. His. Soc.*, Vol. xxxiii, No. 1, p. 96.) a reference was made to the manner in which the mother dugong carries her young. Langvel (*Der Zoologische Garten Ann.*, p. 37, 1896) states that the baby dugong supports itself on the back of its mother. According to Petit (*Bull. Mus. d'Hist. Nat.*, Paris, No. 5, 1927), this was also the opinion of the Malagassy fishermen. It was pointed out that even if the baby dugong was able to take refuge under the breast of its mother, it was not apparent how it could be embraced by the comparatively short flippers of the parent. I have been endeavouring to collect further information on this point and have since received a letter from Mr. M. C. C. Bonnington, Divisional Forest Officer, South Andamans, who writes, 'The Andamanese harpooned a female dugong on the 8th of March carrying a fully formed young. They inform me that females with young are found chiefly during the south-west monsoon.* They also tell me that the mother carries its young when travelling firmly held to her breast with her flippers, but that it plays about near the mother when the latter is feeding.' Mr. Shunker Narayan Pillay, with whom I have also corresponded, was told by the fishermen of Rameswaram that the baby dugong is held so firmly between the flippers by the mother that three strong men were unable to extricate one from her grasp. Mr. Pillay tells me that between November 1928 and 1929, five dugongs were caught at Rameswaram in the fishermen's nets. The animals, as I have stated previously, are highly esteemed as an article of diet by the Mahomedans of the neighbourhood. Mr. Pillay states that no part is wasted, even the viscera are washed and dried and are eaten, seasoned with salt, pepper and turmeric. According to Mr. Bonnington, dugongs are still found in the Andamans in herds up to 20 and Col. M. L. Ferrar, Chief Commissioner, Andamans, writing in this connection states that owing to the practical extinction of the Andamanese and the absence of any successors to these *qua* dugong hunters, there should be plenty of dugongs in those waters.

Bombay Natural History Society, S. H. PRATER,
June 6, 1929. C.M.Z.S.

XVII.—THE SAWN-OFF SHOT GUN—THE WATCHMAN'S GUN.

The question of the preservation of Game and the general Fauna of India and Ceylon is becoming more acute each year. The last few years have seen a marked change in the status of most species that are of any economic value to man, either as food or because of their hides, skins or feathers. In many cases the once common animal has been so exploited and its ranks so decimated that unless some measure of protection or preservation can be accorded it, and that soon, a number of species will very shortly be verging upon complete extermination in many places.

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* Mr. S. Wesche-Dart tells me that he observed a pair of dugongs with a young one in the Andamans in the month of December.

This matter is already receiving attention in many quarters and is exercising the minds of sportsmen and naturalists alike.

One excellent suggestion that has been put forward, to help meet the situation, is the institution of a close season for all animals and birds—a period of so many months of the year during which no shooting of any sort would be permitted. Undoubtedly such a close season is very desirable from all points of view, especially as in many cases that chief damage done to a species is caused by killing in the nesting or breeding season.

But it is always urged that such a close season, although admittedly much wanted, cannot be instituted by our Governments, because it is essential that the villager should be allowed to carry a gun to protect his crops, and in the jungle districts, himself; and this being so, it would be quite impossible to prevent him shooting for food or gain with the gun that he would be permitted to carry.

This argument is sound: but it has been suggested to me that it may be met by the sawn-off shot-gun; a gun cut down until only 12 inches or less of the barrel remains.

A gun of this description would be perfectly efficient for the scaring away, from growing crops, of either birds or animals; and at close range would be as good as, if not better than, an ordinary gun, in the event of an attack by a dangerous animal; but it would be little use for shooting in the jungle.

A watcher on his permit, issued free, would be permitted to own and carry such a gun at any time, but he would not be allowed under any circumstances, to carry a full-barrelled gun during the close season—nor to own one without a special licence—so often the plea for a gun for protecting crops is but an excuse to procure one for the purposes of poaching.

The short-barrelled gun, in addition to its other advantages, would be cheaper to buy, once the demand arose and manufacturers started turning them out.

I shall be interested to hear what you and other members think of this suggestion: is it feasible?

DELTOTE GROUP,
GALAHA,
CEYLON.
August 25, 1928.

W. W. A. PHILLIPS.

[In an article on Game Preservation in India (*Journ. Bomb. Nat. Hist. Soc.*, Vol. xxxii, No. 2, p. 359) the Editors, in discussing the question of gun licences, recommended the suitability for crop protection purposes of a gun with several inches of the barrel removed. EDS.]

XVIII.—OCCURRENCE OF THE TRUMPETER BULLFINCH (*BUCANETES GITHAGINEA CRASSIROSTRIS*) IN THE PUNJAB SALT RANGE.

I met with some small parties of this Finch at the foot of the Salt Range, near the salt mine at Warcha in the Shahpur District, in the middle of January of this year. They were on a steep, bare, and stony hill-side and kept up an incessant twittering, but for which they would probably have escaped my notice, so perfectly did their plumage match the surroundings.

Two males were secured and sent to Mr. H. Whistler, who kindly identified them.

SARGODHA,
PUNJAB,
March 30, 1929.

H. W. WAITE,
Indian Police.

XIX.—MIGRATION NOTES FROM KASHGAR, CHINESE TURKESTAN.

Most duck appear to have migrated North now, but on April 8, I saw a good many teal on one of the rivers close to Kashgar.

On February 26 and 27 I saw many flights of pintail on the Yarkand and Tisuaf rivers between Yarkand and Karghalik, but there were none by March 26.

Duck first appear to come to Kashgar about the middle of September. At that time they go to the open marshes and lakes round about. In mid-November there were very many duck on such places, including mallard, pintail, golden eye, teal and red-crested pochard. As these lakes gradually get frozen over, the duck come into the rivers near Kashgar which are fed by warm springs and do not freeze.

Practically all the duck that stay on the river during December and January are mallard. The following totals of game shot last winter will show the proportions during December and January.

	Mallard.	Gadwall.	Teal.	Golden eye.	Merganser.	Snipe.	Widgeon.	White-fronted goose.
December ...	53	1	...	2	1	1	...	1
January ...	610	...	7	10	3	12	2	...

On January 31, out of 102 birds shot 101 were mallard.

By the middle of February the duck have mostly returned to the marshes and lakes, and the majority seem to leave the district about the end of February and beginning of March.

The following are dates of arrival of birds noticed this spring.

Tern	24th February	Yarkand.
Wagtail	6th March	Khotan.
Hoopoe	14th March	Khotan.
Swift.	27th March.	Yarkand.

BRITISH CONSULATE GENERAL,
KASHGAR,
April 15, 1929.

G. SHERRIFF,
Capt., R. A.

XX.—MORTALITY AMONGST HOOPOE NESTLINGS.

I enclose a photograph showing a hoopoe approaching its nest, made in a disused motor car pit on my verandah, with food for its young ones and mate. The mother bird used to fly up and receive the food from the cock who made small circles round the hole to attract the bird below. She did this until the young birds were big enough to receive the food themselves, when both parents shared the labour of feeding their chicks. The parent birds entered the nest through a hole in the plank. For feeding they did not descend usually but delivered the 'goods' through the hole. Entering the hole for them was quite a business but getting out was really hard work. I have seen the parent birds make three or four efforts before succeeding in squeezing through the hole. Their action was like that of a man in the same predicament, using his elbows and shoulders to lever himself through. There were four young birds, three grew large, but one was minute and eventually died from inanition, I conclude. Is this not rather unusual ?

RAWAL PINDI,
June 11, 1929.

H. M. GRIFFITHS.

[The hoopoes referred to by Mr. Griffiths appear to have been more than usually successful with their brood. Col. R. M. Betham (*Journ. Bomb. Nat. Hist. Soc.*, Vol. xii, p. 688) commenting on the mortality amongst nestling birds mentions that in the case of bulbuls and hoopoes which lay several eggs, rarely more than one young appears to be successfully reared ! Mr. Douglas Dewar (*Birds at the Nest*) makes the same observation. In the book to which we refer he further states that the starvation of at least one young one in the average brood seems to be the rule rather than the exception among birds. The parent birds while they may bring sufficient food to provide for the entire brood in seasons when food is exceptionally abundant do not appear to be able to secure adequate nourishment in average or unfavourable seasons. When this happens at least one of the young is starved. The weak perish while the fittest survive. Which is all for the good of species. With hoopoes the problem of feeding is still more difficult. As with the hornbills, the mother hoopoe never seems to leave her nest until the young are well grown. To the cock bird falls the task of providing food during this period not only for the chicks but also for the mother. The chances of the whole brood surviving are remote. Unfortunately the photo submitted by Mr. Griffiths is unsuitable for reproduction. EDS.]

XXI.—NIDIFICATION OF BINGHAM'S WHITE-HEADED BULBUL (*CERASOPHILA THOMPSONI*)

In the 2nd edition of the *Fauna of British India* (Bird,) Mr. Stuart Baker notes the nidification of *Cerasophila thompsoni* as unknown. Last year, I saw quite a number of the birds at Thandaung, 4,500 ft. in the Karen Hills, 20 miles north-east of Toungoo. Solitary pairs were seen as low as 3,000 ft., while the bird is not by any means rare on the top. It appears to like open spaces, and flies about in the tea garden, perching on dead trees, and often crosses the roads and valleys between hills at a considerable height. Its white head makes it very obvious and it may seem commoner than it is.

Last year, I failed to get a nest, but this year I found one on April 8, containing three fresh eggs. I saw the bird return to the nest and identified it, but could not get a shot, and left my man to secure it. He put it off the nest when he went back from where he had been waiting for me and subsequently shot it. The measurements differ from Bingham's, being :—Length 8″ (7·8″), Wing 3·4″ (3·8″ and 3·7″), Tail 3·1″ (3·8″ and 3·85″), Tarsus ·95 (0·7), Bill from gape ·85″ (·85″). Personal idiosyncrasies in taking measurements may have something to do with this ; I hope to get more specimens, and get them carefully compared. The above measurements in millimetres are 203, 86, 79, 24 and 22mm.

The nest was a surprise. It was placed in a hole in a bank (a cutting for a path) about 3 ft. above the path, and consisted of small bright yellow grass seed stems or rachi of 'Paung' (? *Saccharum arundinaceum*), from which the seed had all been stripped off and a very few pieces of larger grass and bamboo leaves across the outer lip. It was rather a flimsy affair, and came to pieces soon after being taken out. A shallow cup, say 3½″ × 1½″ with no trace of a dome.

The eggs were of the ordinary, fairly, bright-coloured bulbul type ; I think they could be matched from any big series of *Molpastes*, or *Microscelis*. They are blunt at the small end and not very glossy ; the ground colour is a pale pink, fairly densely speckled all over with reddish brown which forms in one egg a cap and in the other two a broad ring at the large end, with underlying markings of a neutral grey.

They measure : 22·5, 22·5 and 23 × 17·5, 16·5 and 17 millimetres.

I have never heard of a bulbul's nest in a bank and it is of course possible that the one found was aberrant. But the construction—flimsy, with a rather stronger sector at the mouth of the hole—is distinctly that of a bird accustomed to breeding in a bank : I thought at first that I had found a *Pellorneum ignotum* nest of unusual construction, and it is possible that the nest has been found before and passed for that of this bird.

I wrote the above on April 15, and since then I have found 4 more nests. One contained 2 young (hatched 17–4–29), one a clutch of 3 eggs and one a clutch of 4. The fourth nest was empty at the time of writing and was probably a second nest. In the two nests mentioned above the eggs were too hard-set to blow. They measured :—C/3—22, 21, 22 × 16, 16·5, 17. Date 16–4–29. C/4—22·5, 23·5, 22, 21·5 × 16·5, 17, 16, 17. Date 16–4–29. The eggs were almost exactly like those in the first nest found. All the nests were in banks, facing more or less east and 2′ 8″ above the path or road. They were all similar in construction to the first nest I took, though they were not perhaps in such a pronounced hole. The situations were rather a fairly pronounced shelf with the back slightly hollow. The usual spot chosen is one where the vegetation is neither very thick nor entirely absent.

Toungoo, Burma, J. M. D. MACKENZIE, I.F.S.
May 11, 1929.

XXII.—EFFECT OF WIND ON THE FLIGHT OF BIRDS.

(*With 2 diagrams.*)

1. *Effect of wind on Soaring Flight.*

The capacity of a kite for sailing through the air without making the slightest motion of its wings depends altogether on the presence of wind. It is not easy to explain the mechanism within the compass of a short note, but I shall try to do so as briefly as possible. When a kite soars in the true sense, that is when it circles round and round and at each circle increases its height, it does not make actual circles but rather a succession of pear shaped figures. I represent them thus.

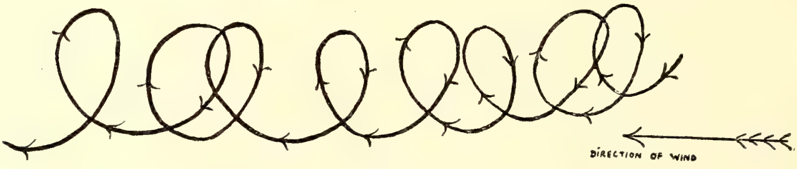

Fig. 1.

Now the capacity to make these figure depends altogether on the presence of wind. If the air is a perfect calm then the bird cannot soar in the true sense. Certainly it may make a fairly long glide, or it may make a short series of circles each of which brings it nearer to the earth, but it cannot circle in such a way that each circle bring it higher into the atmosphere nor continue its circlings for an indefinite time.

The mechanism behind this is very simple but not easy to make clear in a few words. Each circle is a pear-shaped figure and may be divided into segments in relation to the direction of the wind,—

(1) The windward segment, or that part of the segment traced by the bird when it is sailing against the wind.

(2) The leeward segment, or that part of the circle traced by the bird when it is sailing with the wind : represented thus.—

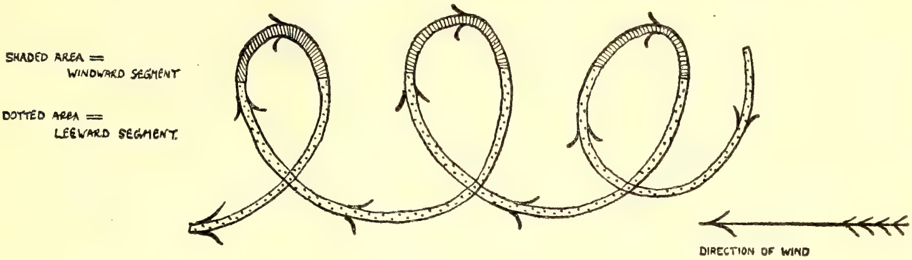
SHADED AREA = WINDWARD SEGMENT
DOTTED AREA = LEEWARD SEGMENT.
DIRECTION OF WIND

FIG 2.

Now the state of the bird is altogether different in the windward and leeward segments of its circles. When travelling on the windward segment, in other words, when facing the wind, the bird is (*a*) gaining in height, (*b*) losing in velocity, (*c*) travelling a shorter segment of its circle, (*d*) tilting up its under surface so as to come at an incline against the wind.

When, on the other hand, it is in the leeward segment, in other words going with the wind, the bird is (*a*) losing in height, (*b*) gaining in velocity, (*c*) travelling the longer segment of its circle, (*d*) resting with its body horizontal in the air.

Thus we see that there is a complete contrast. The four things which the bird does to the windward are exactly the opposite of what it does to the leeward. Why ? The explanation is very simple, when the bird is travelling to leeward, in other words going with the wind, its object is to develop speed. Its longer sweep, its horizontal attitude, the presence of the wind coming up behind it all help to increase its speed. Then when it circles round to windward, that is when it comes up against the wind, its object now becomes to convert that speed into an increase in height. Hence it can make only a shorter sweep and must incline its body against the wind so that the wind may force it upward.

Thus the kite makes use of the wind in two opposite ways. On the leeward side of its circles the wind gives it speed. On the windward side of its circles the wind gives it an increase in height. The circling of a bird is nothing else than the development of energy of motion on the side of the segment of the circle with the wind, and the conversion of that into energy of position on the segment of the circle against the wind.

But all depends on the presence of wind, without which true soaring is impossible, and by true soaring I mean continuous circling without the slightest motion of the wings and associated with an increase in height.

Effect of wind on Hovering Flight.

Birds that poise themselves stationary at one point in the air, kestrels, kingfishers, terns, for example, make the greatest use of the wind in carrying out these hovering operations. Two points are very obvious, (1) that these birds always face the wind while engaged in the act of hovering, and (2) that they hover with greater ease and facility when the wind is strong than when it is weak. Now why is this? Why is it an advantage to a hovering bird to face a strong wind? Here again I think the explanation is simple. When a bird is in the act of hovering, its wings, each time they are lowered, are thrust in a downward and backward direction. The downward element of the thrust helps to raise the bird, the backward element to push it forward. It remains fixed in the air at one spot. It must in some way counteract the forward push of its wings, which it does by the simple mechanism of persistently facing the wind. No bird can empoly its wings for the purpose of just raising itself vertically; there must always be some forward-pushing element in the strokes. Hence it always faces the wind and hovers more easily when the wind is strong.

Effect of wind on flight at Extreme Altitudes.

I think that at great altitudes birds make use of the wind even more noticeably than they do at sea-level. It is remarkable that they can perform their aërial evolutions at altitudes where the supporting power of the atmosphere is considerably reduced. Soaring flight, for instance, which we have seen is dependent on wind, is performed with perfect ease at 15,000 feet where the supporting power of the atmosphere is reduced to one half. Also I have seen the Lammergeyer soaring at 22,000 feet where the supporting power is still less. Hovering we have seen is dependent on wind, moreover I think that of all the aërial evolutions of birds, it is the one that demands the greatest muscular effort, yet both the kestrel and the tern hover freely where the air has only half its supporting power. So far as ordinary flight is concerned, it has been observed that choughs can fly perfectly well at the immense height of 27,000 feet. Thus it is clear that the lifting power of the air is not of such importance to the flight of birds as has hitherto been thought. I believe that the direction and the force of the wind are factors of far greater importance.

PALL MALL, LONDON. R. W. G. HINGSTON,
April 1, 1929. *Major.*

[In vol. xxx, p. 479 of the Society's *Journal* we published a note by Capt. J. A. Chamier, Royal Air Force on the 'Mechanics of the Soaring Bird' to which Mr. C. H. Donald contributed an interesting comment.

A note on 'Wind and the Flight of Wild Birds' appeared in the *Field* of January 24, 1929. The writer comments on the effect of wind on the flight of rooks. The birds were perfectly helpless against the wind which caught them and whirled them about. A wedge of Pink-footed Geese, flying low, were however unaffected. The direction of the wind, the writer believes, seems to have much more effect on the height at which birds fly than the force of it.

From limited observation, he was of opinion that in a wind veering from north to south, following the sun geese as well as ducks fly very high. Other winds bring them low. In an endeavour to collect further information on this point we corresponded with various members of the Society. The note published above is from Major R. Hingston. We welcome comments from other observers. EDS.]

XXIII.—THE SURVIVAL OF THE GAVIAL (*GAVIALIS GANGETICUS*) IN BURMA

(*With 3 text figures*).

Mr. Barton's note (*Journ. Bomb. Nat. Hist. Soc.*, vol. xxxiii, No. 2, p. 450) recording a specimen of the Indian Gharial shot in Upper Burma is most interesting. I would like to comment however upon one of his remarks. He says 'the fact of its being killed in the Shweli, well over a thousand miles from the delta of the Irrawadi, is of great interest'. Does Mr. Barton mean that the Indian Gharial was originally a deltaic or estuarine species and that it gradually extended its range up the Irrawadi as far as the Shweli. There is nothing in the past history or in our present knowledge of the creature to suggest such a theory.

The *Gavialidæ* are an ancient family, and were at one time, much more widely distributed than they are to-day. During the Tertiary epoch they ranged over Asia, North America and Europe. Of this great host only two species now survive, namely, *Gavialis gangeticus*, the Indian Gharial and *Tomistoma schlegeli*, the Malayan Gharial. The genus *Gavialis* flourished in India during the Pliocene period. Lydekker has described no less than five fossil forms from the Siwalik hills and the Narbudda valley, one of which is indistinguishable, as far as we can tell, from the *Gavialis gangeticus* which exists to-day. In considering the distribution of this ancient reptile therefore, probably the oldest of all the living Crocodilia, we must remember that it dates back to a time when the geographical configuration and the river systems of the country were no doubt very different from what they are to-day. Those that we see now are the survivors of a former wider distribution. The fact that they have escaped notice on the Irrawadi for so long is because only a few individuals are left there.

While on the subject of crocodiles I should be glad if any reader of this Journal can tell me of an authentic record of the Mugger, *Crocodilus palustris*, in Burma. Its distribution is given by Boulenger, in the *Fauna of British India*, as India, Ceylon, Burma, the Malay Peninsula and Archipelago (Java). This I showed in 1919 (*Journ. Nat. Hist. Soc. Siam*, iii, p. 220) is not correct. The fresh-water crocodile of Siam, French Indo-China and the northern part of the Malay Peninsula (Patani) is *C. siamensis*, while the most easterly record of the Mugger is from the Brahmaputra, Darrang district, Assam (Annandale, *Rec. Ind. Mus.*, viii, 1912, p. 38). I do not know of any authentic statement or specimen to shew that it exists in Burma or anywhere outside the Indian region. If it does live in Burma it is probably north of lat. 17° N. The fresh-water crocodile of Tenasserim, if there is one, is almost certainly *C. siamensis*, which is common on the Quaa Noi river, just across the border, north of Tavoy. It is unlikely that two closely allied species will be found living side by side.

Three species of crocodile inhabit Asia, namely *C. palustris*, the Mugger, *C. siamensis*, the Siamese Crocodile and *C. porosus*, the Estuarine Crocodile. The first two are, I believe, strictly fresh-water species, the third equally strictly estuarine and marine in its habitat. Any records of the Indian Mugger in estuarine waters are probably wrong identifications. Occasional individuals, particularly youngsters, may get carried down to the mouths of rivers, but they are exceptions.

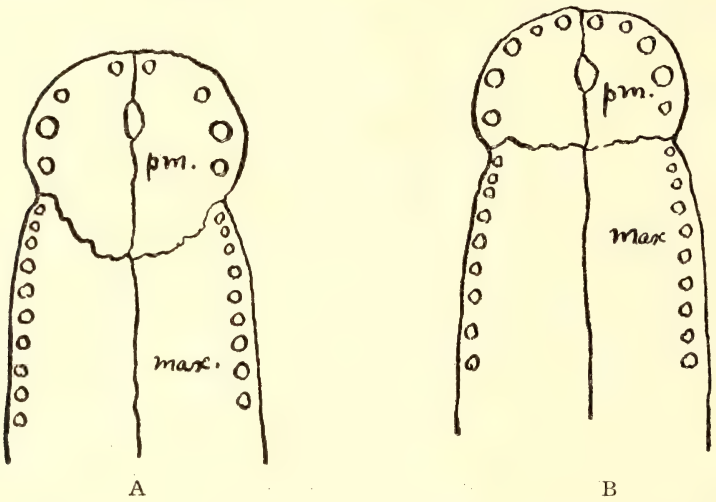

Fig. 1. A. Palate of *Crocodilus porosus* and *siamensis*.
B. Palate of *Crocodilus palustris*.

The three species are quite distinct, and if careful attention is paid to the following characters can be readily distinguished from one another. Externally they all look much alike until fully grown, when the different proportions of the snout are a fair guide.

I. Four teeth in each premaxillary bone in the adult; premaxillo-maxillary suture curved backwards or W-shaped; a more or less strong ridge extending forwards in front of each eye. (Fig. 1 A.)

Snout $1\frac{2}{3}$ to $2\frac{1}{6}$ times as long as broad at the base; bony portions of the dorsal scutes separated from each other by soft skin; post-occipital scutes usually absent (Fig. 2) ... ... *porosus*.

Snout $1\frac{2}{3}$ to $1\frac{5}{6}$ times as long as broad at the base ; bony portions of the dorsal scutes in contact with one another in a transverse series ; one or two pairs of post-occipital scutes (Figs. 1 A & 3) ... *siamensis.*

II. Five teeth in each maxillary bone in the adult ; premaxillo-maxillary suture directed more or less straight across the palate ; bony portions of the dorsal scutes in contact with one another in a transverse series ; snout $1\frac{1}{3}$ to $1\frac{1}{2}$ times as long as broad at the base, without distinct ridges (Figs. 1 B & 3) ... *palustris.*

The premaxillo-maxillary suture can be seen by lifting up the membrane covering the bone inside the mouth ; the outlines of the

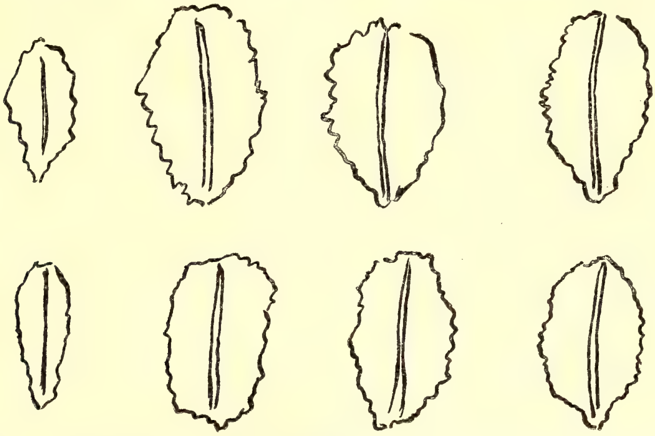

Fig. 2. Dorsal armour of *Crocodilus porosus*. The horny external skin has been removed.

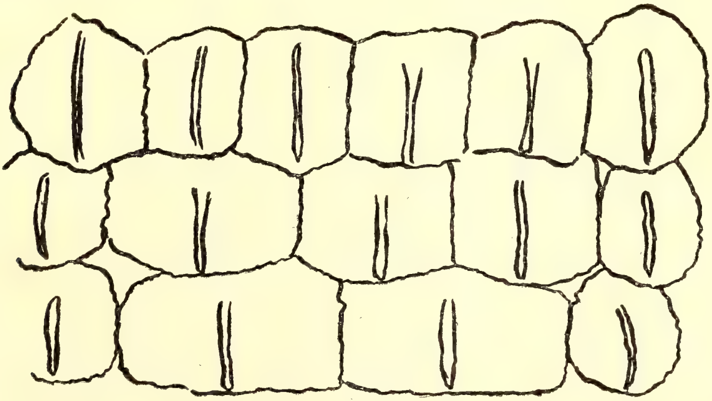

Fig. 3. Dorsal armour of *C. palustris* and *siamensis*. The horny external skin removed.

bony portions of the dorsal scutes can be seen externally or better still by removing the horny cuticle which covers them ; or when the skin is removed can be seen by transmitted light.

Since writing the above I have seen a note by Theobald of a specimen of *C. palustris* killed at Thayetmyo, on the Irrawadi (*J. Linn. Soc., Zool.*, x, 1868, p. 20). It was a full-grown specimen, 12 feet long, and had recently killed a man. He remarks that *C. palustris* is evidently very rare in Burma, as it is the only example he has ever seen.

Later in 1882 he wrote of *C. palustris* ' rare in Burma, but is found inland about Thayetmyo, and thence up the Irrawadi ' (*Burma, Its People and Productions*, p. 335). Although in his writings Theobald confused *palustris* with *porosus* there can be little doubt, from the locality in which it was found, that the crocodile to which he refers was not *porosus*.

LONDON,
April 10, 1929.

MALCOLM SMITH.

XXIV.—NOTE ON A FORMOSAN VIPER (*TRIMERESURUS MUCROSQUAMATUS*) FROM THE NORTH-EAST FRONTIER

The Society recently received a fine example of a Formosan Viper (*Trimeresurus mucrosquamatus*) from Mr. J. N. Saikia, Medical Officer, Pasighat, N.-E. Frontier. The snake agrees with descriptions of Formosan specimens given by Boulenger in the *Fauna*, Brit. India, *Reptilia*. The costals are 23, two head lengths behind the head, and 25 in mid-body. Ventrals 200, Sub-caudals in 73 pairs. Length 3′ 7″. The colouration differs in that the lower parts are yellowish grey with irregular square-shaped white markings.

BOMBAY NATURAL
HISTORY SOCIETY,
April 15, 1929.

S. H. PRATER,
C.M.Z.S.

XXV.—RECORD OF SYMPTOMS AND TREATMENT OF A BITE FROM A FORMOSAN VIPER

(*TRIMERESURUS MUCROSQUAMATUS*)

A forest cooly was bitten by the above named viper on the inner side of the left foot at about 3-30 P. M., on the evening of the April 10, 1929. The man walked 3½ miles to the hospital where he was admitted at about 6 P. M.

He complained of pain at the site of the bite and all over the limb and in the inguinal gland of the affected limb. The whole limb and the gland were swollen to about twice the size of the corresponding limb.

On examination (with a lens and naked eye as well) one puncture mark was noticed on the inner side of the left foot about midway between the inner maleoli and the heel. Sero-sanguineus fluid was oozing from the puncture.

10–4–29	No general symptoms. Pulse and respiration normal. Visited patient at 9 P. M. No further symptoms.	A few crystals of permanganate of potassium were rubbed into the wound and the part was bandaged. Cal. Lactate gr. xv every four hours.
11–4–29	Patient had not slept well. Pain and swelling almost the same. Serous fluid still oozing from puncture.	Crystals of permang. potass. rubbed in the wound. Intra muscular injection in the buttock of 4cc. of 2% solution of Cal. Lactate was given.
12–4–29	The swelling of the limb diminished and less pain complained off.	Cal. lactate gr. x.
13–4–29	The patient gradually improved.	,,
16–4–29	Limb almost normal. No pain.	,,
17–4–29	Swelling and pain nil. Patient discharged at own request.	

PASIGHAT,
N. E. FRONTIER,
April 18, 1929.

J. SAKIA,
Medical Officer.

XXVI.—MAHSEER FISHING AT TANGROTE, JHELUM DISTRICT IN DECEMBER.

As mahseer fishing in the winter is often considered unprofitable in Northern India the following note may be of interest to anglers.

Fishing from December 15 to 29 my wife and myself caught 18 fish weighing 261½ lbs., average weight 14½ lbs.

Out of these 15 days 7 were blank, 6 indifferent, 1 good and one A.1. On four of the blank days we did not try to fish as the water was hopelessly clear.

The best day, the 29th more than made up for the blank ones, for we caught five fish, 47½, 28, 22½, 16 and 11 lbs. = 125 lbs; besides playing three or four other large fish, which were not brought to gaff. These fish were all caught on a 3½″ Blue Devon.

The Poonch river, after heavy rains on the 28th was really dirty and according to the shikaries unfishable, except possibly with *atta*. However the first chukkar down Jungoo Pool produced a 16 lb. and the second a 28 lb.

The fish were taking a Devon most readily all day but an extraordinary fact was that all fish were hooked chukkering down stream. Another fisherman had even a better day and caught 6 fish weighing, as far as I remember, over 140 lbs. and all, save one, while moving down stream. This day is almost a record for Tangrote and certainly a record for December.

On the 28th we caught three fish 45, 16 and 7 lbs. on a Blue Devon. The 45 lb. one being foul hooked in the tail, put up a remarkable fight.

Has any reader had a similar experience of only catching fish, when chukkering one way ?

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W. H. C. JONES,
Captain.

XXVII.—MEANS OF DEFENCE IN INSECTS.

The slow loris (*Nycticebus coucang*) referred to on a previous page of this Journal (Miscell. Note No. II, p. 966) ate almost any insect but I found one type of grasshopper in Maymyo which it rejected. When it started eating one of these—after a long and most unusual delay—a short of green foam appeared and it would touch no more.

TOUNGOO, BURMA
May 11, 1929.

J. M. D. MACKENZIE.

[The secretion of nauseous substances which when discharged are offensive to the smell, taste, sight or touch of the aggressor is a well known means of defence amongst insects. Mr. Mackenzie does not mention the particular species of grasshopper concerned in the present instance. The grasshopper best known for its habit of discharging a nauseous liquid which oozes out in the form of small bubbles is *Aularchis miliaris*, a widely distributed species. The manner in which the loris profitted by his unpleasant experience is a good instance in proof of the effectiveness of this means of defence amongst insects and of the immunity from attack which it confers on such species as exhibit it. After his first trial the loris, it will be observed, left this type of grasshopper severely alone. EDS.]

XXVIII.—ON A NEW FORM OF HESPERID BUTTERFLY (*BAORIS CANARICA YATESI*) FROM COORG.

I recently had the opportunity of examining a series of *Baoris canarica*, forwarded to me through the Society by Mr. J. A. Yates. Until recently the only specimens that I had ever seen were 2 pairs, dated October, 1898, from Mr. T. R. Bell in Kanara. From these I described the underside of the hindwing as : 'with a broad, pale central fascia caused by the greenish ochreous scales being rather denser there; normally decreasing white spots in 2 and 3 which do not appear above.' Incidentally one of the ♀♀ has a spot in 6 also, but the pale fascia is not very prominent and is pale greenish ochreous. From Rothschild, I have a ♂, dated August, which is like my Kanara specimens and a ♀ with a broad white (not greenish ochreous) band, having the spots in 2 and 3 only just traceable: the ♀ is dated February. Both are very fresh specimens.

Yates's 7 ♂♂ and 1 ♀ range from January 21 to March 11, 1929, and, except for 2 obviously rubbed specimens, have the white band strongly developed and the discal spots in 2 and 3 barely traceable: this is the same as in the 2 ♂♂ he sent me before, dated January 21, 1929.

Now Moore in his original description describes the underside of the hind-wing as having 2 discal white spots in the ♂ and 4 in the ♀ with an additional spot at the end of the cell—no mention of a fascia: he gives the locality as Kanara. Neither Watson nor De Nicéville had ever seen *canarica*, nor had Elwes for his *Oriental Hesperidæ*. Swinhoe in *Lepidoptera Indica* states that the underside of the ♂ has a broad discal white band, mentioning no spots and that the ♀ differs in having 'minute discal white dots' in 2, 3 and 6. He gives Karwar as the only locality. Bell in his 'Common Butterflies' copies Swinhoe, describes the larva but does not give dates of capture and states that *canarica* has never been caught out of North Kanara. Hannyngton (*Butterflies of Coorg*) recorded it only from the 'Western slopes, May and August', I conclude that there are 2 broods—WSF, probably May-October, as described by myself and Moore, whose ♀ was probably *conjuncta* and a DSF, probably December–April with the white band. The two broods seem very distinct and as naming broods is now fashionable, I propose the name '*yatesi*' for the DSF brood since *canarica* obviously refers to the WSF brood.

QUETTA,
May 13, 1929.

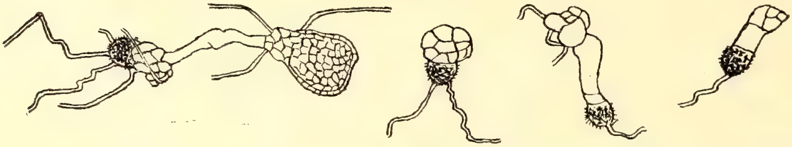
W. H. EVANS,
Brigadier.

XXIX.—THE DISCOVERY OF GERMINATION OF *CYATHODIUM* SPORES

(*With a diagram*)

It is now more than fifty years since the observations on the interesting genus *Cyathodium* were first recorded. During the interval that has elapsed our knowledge of the life-history of this plant has become fuller by the contributions of a number of botanists, amongst whom the names of Leitgeb, Stahl, Kamerling, Lang and Kashyap may be mentioned. But so far as I am aware a very important stage in its life-history, viz., the germination of the spores, has so far remained undiscovered. It may, therefore, be not out of place to record this discovery here, and to invite attention to certain novel and interesting features as observed by me.

The most notable departure is the occurrence of a number of germ pores. So far as the published figures in the literature which I have been able to reach on the subject enable me to judge, in all the hitherto recorded cases of germination of the liverwort spores, with the exception of *Targionia* mentioned below I find there is a single germ pore from which both the germ tube and the rhizoid make their exit. In the present case, however, the number of germ pores varies from two to four, the latter being the largest number so far observed by me. From one of these pores emerges the germ tube; from the others the rhizoids, as shown in the figures that follow :



Germination of *Cyathodium* spores.

The spore also seems to possess a distinct polarity in as much as the rhizoids take their origin generally from one-half of the spore and the germ tube from the other half, and I have not yet come across a single case, although a large number of spores have been examined, where there was a common exit for both. The only other case of a more or less similar nature known to me is that of *Targionia* mentioned and figured by Campbell (Mosses and Ferns). In view of this close similarity in their germinating spores, besides other resemblances already known, it would appear that the two genera are really closely related in spite of their widely differing vegetative character.

It may be a matter of some surprise to find that the germination of spores so far remained undiscovered in the genus. A possible explanation may lie in the fact that most of the previous investigators seem to have studied preserved material, sometimes months after it was collected. In such circumstances I find that it is easy to miss the germinated spores. Further I have also not yet succeeded in artificially inducing germination in fully ripe spores, after a number of trials according to the well-recognized culture methods, although in nature one hardly fails to discover a rich crop of spores in various stages of germination. It may be that they can only germinate after a prolonged resting period. This will be tested in due course.

The specimens of *Cyathodium* to which this note relates were collected in the months from August to October 1928 from a *kucha* drain in the Benares Hindu University grounds. It has not yet been possible to refer them with certainty to any of the hitherto described species[1] on account of a number of transitional and certain novel characters, both in the vegetative as well as in the reproductive parts. Detailed study is in progress, some of the results of which were communicated in a paper to the Botany Section of the Indian Science Congress held at Madras in 1929.

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[1] Since the above was written the author has learnt from Dr. K. Goebel of Munich that the specimens are identical with *Cyathodium cavernarum*.

I shall be glad to receive suggestions and criticisms from other botanists interested in the subject.

BENARES HINDU UNIVERSITY, N. K. TIWARY.
DEPARTMENT OF BOTANY,
June 12, 1929.

XXX.—SOME ORCHIDS NOT PREVIOUSLY RECORDED FROM THE GANJAM DISTRICT, MADRAS PRESIDENCY

I have interested myself personally in the orchids which are to be found in the Ganjam Agency and in some places in the adjacent plains. Some of these, which have been identified for me by the Secretary of the Agri-Horticultural Society of Calcutta, are not to be found in Gamble's *Flora of Madras*, part viii (Fischer), and it is perhaps as well that their existence should be put on record. The following have been identified :—

1. *Ærides odoratum :* also to be found in the semi-Agency country north of Russellkonda;
2. *Vanda tessellata*, v. *Roxburghii :* abundant also at Surada and at Parlakimedi ;
3. *Vanda parviflora :* also found at Surada in association with the previous species ;
4. *Trichoglottis* or *Sarcochilus :* not in Gamble's *Flora*, but a fairly common orchid in this Agency ;
5. *Luisia ? :* commonly found on very old mohwa trees (*Bassia latifolia*), awaiting exact identification till its October flowering ;
6. *Dendrobium aduncum* (?) : only observed once at R. Udayagiri (2,000 ft.) ; has flowered at Chatrapur however ;
7. *Rhynchostylis retusa :* also found at Parlakimedi ;
8. [Still not in flower ; only in bud ; will be sent for identification shortly].

Of three or four others the identification is impossible in the absence of a flower. Although as many as forty varieties of *V. tessellata* have been recorded, two collected by me at Surada were unknown to Mr. Lancaster ; in this place the plants are found epiphytic on tamarind trees by the roadside. In the Agency the commonest host is the mango ; and next to it I should say the mohwa. I believe there is in this and in other directions a considerable opportunity for extending the record of the flora of the district.

C. HENDERSON, I.C.S.

GANJAM,
June 15, 1929.

PROCEEDINGS

A meeting of the members and their friends was held at the Prince of Wales Museum on Tuesday, July 23, at 6.30 p.m. Prof. V. N. Hate, M.A., presided.

The Honorary Secretary, Sir Reginald Spence, announced the election of the following 22 members since the last meeting held on March 26, 1929 :—

Dr. J. O. Beven, Ceylon ; Mr. A. J. Hopkinson, I.C.S., Kathiawar ; Mr. D. G. Leonard, Bombay ; Mr. A. E. Irvine, Ootacamund ; Mr. R. O. Miller, Razmak ; Rev. John D. Harris, B.A., B.D., Belgaum ; Mr. R. C. Hodgson, Patna ; Lt.-Col. C. S. Steele-Perkins, Calcutta ; Rear Admiral Herbert Lynes, C.B., England ; Group Captain H. LeM. Brock, D.S.O., Royal Air Force, Peshawar ; Mr. R. B. Ewbank, C.I.E., I.C.S., Bombay ; Mr. J. B. Twinberrow, M.C., I.P., England ; Mr. C. N. Silvester, I.S.R., Quetta ; Capt. G. E. R. S. Hartigan, M.C., Lansdowne, U.P. ; The Principal, Medical College, Vizagapatam ; Col. E. F. Norton, M.C., D.S.O., Quetta ; The Lord Ashley, Government House, Bombay ; Mr. L. O. Welch, Nasirabad ; Mr. R. White-Cooper, Mhow ; Mr. J. S. Anderson, Bombay ; Mr. H. N. Rees, Tavoy, Burma ; Lt.-Col. H. G. Martin, Quetta.

THE SOCIETY'S PUBLICATIONS

The Honorary Secretary drew attention to the efforts the Society was making to produce a more attractive Journal. No. 3 of this volume, the number just in the hands of the members was really a ' Bumper ' issue. Superbly illustrated, with no less than 5 colour plates, it contained a number of popular articles, chief amongst which was one which will supply a long felt want in India—the serial on Some Beautiful Indian Trees. India is justly proud of its profusion of beautiful flowering trees and there are many who want to know something of the history, habits, uses and methods of cultivating these trees. The present serial should supply this information. The authors, the Rev. E. Blatter and Mr. W. S. Millard, propose to describe and illustrate in colour some 35 different species of Indian trees remarkable for the beauty of their flowers. Members are now receiving more value for their annual subscription than they have ever done before and it is hoped that they will reciprocate by inducing others to join the Society.

The Honorary Secretary announced that the Society hoped shortly to bring out the 3rd Volume of the Indian Game Birds. This Volume will deal with the Pheasants. It will be issued in the same format as the two preceding Volumes and will be as beautifully illustrated. Members will be able to purchase the books on especially favourable terms, another instance of the advantages of membership.

Another activity of the Society which is of general interest is the forthcoming publication of a series of charts illustrating 200 Common Indian Birds in colour. The Charts are primarily intended for the use of schools. As an accompaniment to the charts, it is proposed to issue a book descriptive of the habits, etc., of Indian Birds, which book would have 100 coloured plates illustrating 200 birds, as well as black and white plates illustrating habitat, nesting, etc. Advance copies of the coloured illustrations had been received from the Society's printers and were shown to members.

SEED DISPERSAL

Mr. C. McCann, Assistant Curator, delivered an interesting lecture on the subject of Seed Dispersal. The lecturer described the many ingenious devices and the agencies whereby fruits and seeds of plants were scattered far and wide and whereby a particular species of plant increased its territory. The principal agencies for Seed Dispersal were the wind, water and the intervention of animals, the chief of which was man. Wind-borne seeds were assisted in their aerial journeys firstly by their intrinsic lightness and by structural adaptations such as wings, and other appendages which supported the seed or the fruit in its passage through the air. A familiar example was the seeds of Silk Cotton tree which were buried in an investment of silk and which, on the bursting of the ripe pod, were borne through the air and deposited far from the parent plant. The seed of the Ak or milk plant (*Callotropis*) whose silk provided the Kapok of Commerce was another instance. This seed is furnished with a gossammer silken parachute which sails through the air for many miles before dropping its seed. The lecturer illustrated yet other examples of wind-borne seeds. The commonest example of a seed adapted for lengthy journeys on the surface of the water was the Coconut. Its water-proof skin, its light though perfect protective investment of fibre and shell, which secured the kernel from all damage, enabled the fruit to be borne safely for thousands of miles across the sea. It was due to these adaptations that the Coconut was carried across the sea from its original home off the coast of Panama to cover the various islands of the Pacific and establish itself finally on the shores of India and its neighbouring Islands. He suggested that a similar explanation would cover his discovery of a complete Brazil nut on Juhu Sands, Bombay. Devices of plants to scatter their seeds were well illustrated in the fruits of the common Garden Balsam. The seed-cases of the mature fruit curled inwards with considerable force and thus ejected the seeds. The mysterious clicking sound heard in the neighbourhood of *Euphorbia* bushes, commonly though erroneously referred to as the Cactus, were caused by the bursting of the fruit and the consequent expulsion of the seeds. Seeds fitted with hooks and other devices for attachment to passing animals were a common example of plants which relied for their dispersal on external agents. The burrs and spiked seeds of grasses, a constant source of annoyance in a cross country walk, were familiar instances. Through this agency the seeds were carried and deposited far from the parent plant. Through feeding on fruits and seed, birds and animals were also effective though unconscious agents for seed dispersal. The presence of a young Banyan or Fig tree growing on the wall of a building was due to some animal or bird in the natural course of events dropping its seeds there after feeding on the fruit.

The principal agent for seed dispersal was man. By his continuous importation of whole plants or seeds, man had assisted considerably in the wider distribution of species often to his own detriment. The *Lantana* bush, imported as a garden plant into Ceylon from America, became a perfect pest in Ceylon and the cause of considerable annual losses to Ceylon and Indian Revenues.

The lecture was illustrated with a fine series of lantern slides and with actual specimens of fruit and seeds.

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RECORDS OF THE HIMALAYAN CLUB

EDITED BY KENNETH MASON PRICE RUPEES FIVE

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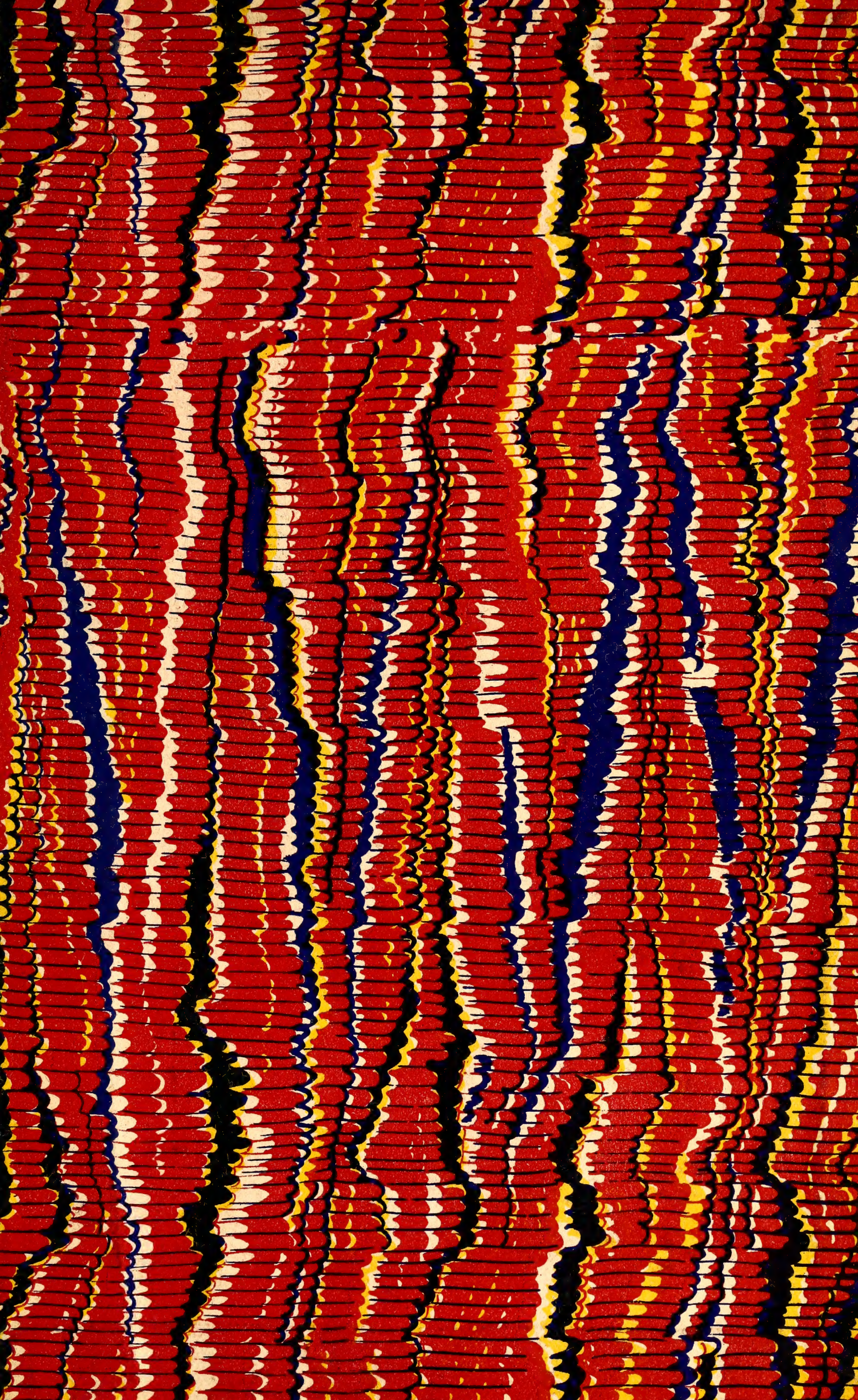

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